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Science Careers for Women

• By **Howard A. Meyerhoff, Ph.D.,** *(Columbia University)*
EXECUTIVE DIRECTOR, SCIENTIFIC MANPOWER COMMISSION, WASHINGTON, D. C.

This is a challenging article.

"With shortages of manpower in so many professions, women have an unparalleled opportunity to entrench themselves more firmly in those in which they now have only a precarious toehold."

Can an able woman hold her own in vocational fields now dominated by men? How about an aptitude for mathematics?

"Those young women who feel the urge or hear the call to enter a scientific or engineering profession should at least try out for it, regardless of the 'advice' of family, friends, or counselors. . . . For such people . . . there is a fascinating future, to which a lively imagination and thorough training make equal contributions."

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Serious concern has been expressed in recent months about the huge number of engineers and scientists being trained in Russia. This year 50,000 engineers graduated from Russian schools, whereas the United States turned out a scant 20,000. If the pace is maintained, by 1960 there will be as many engineers in the USSR as in the U. S., and by 1965 the numbers of scientists will be approximately equal in the two countries. Already, in Russia, there are many more technicians with semiprofessional training, and this year 150 new technical schools were opened, so that her highly trained technologists will not lack for supporting personnel.

The transformation that is taking place in the USSR cannot be regarded lightly, even when one realizes the price that is being paid for it. Young people are being recruited for scientific and engineering careers at the expense of the humanities and the social sciences. The program, implemented by propaganda and subsidy, not by harsh compulsion, is skillfully designed to provide the trained manpower that the Soviet State so urgently needs; there is little inducement—and not too much opportunity—to elect professional careers in nonscientific fields.

Approximately one quarter of the Russian graduates in engineering, and slightly more in science, are young women. This fact has prompted several prominent U. S. educators to publicize career opportunities for women in the several sciences and in engineering. The Secretary of Labor and the Director of the Women's Bureau in the Department of Labor, not to mention the Director of the Office of Education, have pointed to the bright future that these professions offer. In June a conference on the subject was held at Bryn Mawr, and in December it was revealed that President Eisenhower's Cabinet Committee on the Training of Scientists and Engineers advocates the recruitment of many more women.

There is at least a dash of hysteria in this sudden concern about interesting many more women in science and technology. It derives from the fact that we have been critically short of trained personnel since June, 1950. Thanks to the low birth rate of the thirties, the high level of our economy, and the absence of anything resembling a sound policy for the effective utilization of manpower, the situation has deteriorated steadily. But the fact that we need new recruits from untapped sources, and that the Russians are turning out two and one-half times as many technologists as we are, of which one quarter are women, does not offer a single good reason for the girls who are graduating from our high schools to queue up at the doors of science classrooms in our colleges. The plain truth is that the men are not the least bit worried about being trampled by a stampede of female freshmen in the engineering schools. There is, however, room for many more, and especially for those who have a genuine liking and a demonstrated ability for the precision that is so basic to science and engineering.

Mathematics provides a searching test of ability, and it is significant that 1274, or twenty-nine per cent, of the bachelors' degrees awarded in mathematics in 1953 went to women. Relatively few continue graduate studies except in home economics, dietetics, and related subjects, but, even so, *112* earned masters' degrees and *14* Ph.D.'s, in mathematics. In view of this showing, it is surprising that so few specialized in physics and engineering, where mathematics finds many practical and interesting applications. In 1953, only 84 coeds received bachelors' degrees in physics, 37 in engineering. At the master's level, 35 were awarded degrees in physics, 13 in engineering. Six earned Ph.D.'s in physics, but only one courageous female received a doctor's degree in engineering!

Admittedly, it takes courage for a woman to enter vocational fields dominated by men. Her troubles may begin very early in her college career, for in many coeducational schools male teachers, accustomed to dealing with men, seem to adopt the slogan "They shall not pass!" when they find women in their classes. Actually, any able woman can easily hold her own in such a competitive situation. Although most science majors are serious and capable, men students in general have sloppy or erratic study habits, against which systematic class preparation and consistent performance stand in startling contrast. It's a rare teacher who does not succumb to the charm of a student, male or female, who takes an intelligent interest in his course.

In the stratosphere of graduate work, there are only a few archaic departments in which prejudice against the woman student persists. Elsewhere, merit becomes the sole consideration after it appears certain that the girl graduate wants to earn, rather than marry, a Ph.D.

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Timing a Solar Eclipse

• By Jay F. Kunze
GRADUATE STUDENT, DEPARTMENT OF PHYSICS, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH, PENNSYLVANIA

An informative first-hand account of the timing of a solar eclipse, told by a young man who participated in a study of the 1954 total eclipse, at a base in northern Labrador.

Mr. Kunze tells the purpose of the work and the value of the findings to science and the government. He explains why travel to remote and difficult regions is often necessary, what equipment must be taken, the advance preparation that is required, and the actual work done during the eclipse.

The writer thanks the Reverend Francis J. Heyden, S.J., of the Georgetown College Observatory, Dr. N. E. Wagman, Director, Allegheny Observatory, Pittsburgh, and Captain R. J. Ford of the U. S. Air Force for their kindness in reading the manuscript of this article.

A total eclipse of the sun was an awesome sight to the ancients. Seldom did man see more than one in a lifetime, and when it occurred without warning, he believed it to be a sign that his gods were becoming truculent. Ancient man knew neither the cause nor the effects of a total eclipse. Modern man certainly understands the cause, though the nature of the effects is still nebulous. Astronomers are not the only men who enjoy an eclipse, for it is bound to cause everyone to marvel at the intrinsic and unique beauty of the multicolored corona and the peculiar darkness.

There are at least two solar eclipses a year, but these can be of several different kinds. A partial eclipse is quite common; the average person can view several dozen during a lifetime, weather permitting. The moon's disk only partially obscures the sun at these times, and an adequately darkened glass is needed to view the event. There is no noticeable darkening of the sky, and the partial eclipse has little scientific value.

At points on the earth's surface where the moon's disk passes directly in front of the sun during an eclipse, two possible events can occur. If the moon is far away from the earth (near apogee), the eclipse is annular, and a ring of sunlight remains around the edge of the moon. However, this event has less scientific value than the similar condition when the moon is not near apogee. At such times the new moon can completely obscure the sun for a period never exceeding eight minutes. This is a total eclipse. The beautiful corona is visible, and scientists have ideal conditions for studying the upper atmosphere of the sun.

The Theory of Relativity was confirmed partially by measuring, during total eclipses, the gravitational bending of light by the sun. The time of mid-totality can be quite accurately determined from various stations along the path of totality as the moon's shadow moves across the earth. It is this latter source of information that has become very valuable to the government in compiling geodetic information.

The essence of the timing method is to establish accurately the geographical positions of those points for which the time of mid-totality was determined. The reduction of the data provides corrections for the terrestrial radius and lunar distances, and for the distances between points on the earth's surface. Further information may also be obtained regarding the oblateness of the earth.

A total eclipse of the sun at one spot on the earth is rare, occurring on the average about once in every 350 years. Seldom does one occur over densely populated areas. Therefore it is often necessary to send small groups of men with equipment to isolated and remote points of the earth to gather eclipse data. The June 30, 1954, total solar eclipse path extended from Nebraska, northeast into Canada and the sub-arctic regions, through northern Europe, and ended in Iran. Seventeen eclipse sites were stationed along this eighty-mile-wide path.

Three methods for determining the time of mid-totality were used. Two of these, the Bonsdorff and Lindblad methods, require a small telescope. They utilize photographs of the shape of the crescent and its spectrum, respectively. The third method, that of Gaviola, uses a continuous record of the photoelectric intensity of the sun's light. Photoelectric observations require relatively inexpensive equipment that is light in weight and simple to assemble and operate. The

VIEW OF CAMP. Squad tent on left, instrument tent on right, generators in between. The snow field on the hillside provided a satisfactory water supply.

method has the further advantage that its success does not depend upon clear skies, which are absolutely essential for the Bonsdorff and Lindblad methods. The photoelectric observations have been successful with both partly clouded and completely overcast skies, as well as with clear skies.

The main organization in the 1954 eclipse project was the Geophysics Research Directorate of the Air Force Cambridge Research Center. The project was under the direction of Capt. R. J. Ford. The observers and equipment were transported to the sites by the Military Air Transportation Service. The information gathered will be utilized by the Geophysics Research Directorate, by the National Bureau of Standards and by civilian astronomers.

To most individuals, it is not intuitively obvious why the accurate timing of an eclipse to obtain more accurate geodetic information will be of much military value. Its value seems to be limited to what is frequently called "pure science." In modern offensive or defensive war, the success of a military organization depends upon the developments of science, and the efficiency with which the military unit utilizes these developments. Perhaps one can attribute our present military strength to the perspicacity of the strategists who have provided the means for basic research, and have utilized its results. This point is illustrated by the atomic energy program.

The eclipse program functions through the cooperation of civilian and military scientists. Astronomers have desired eclipse information, but have been unable to obtain it because of the limited budgets of most universities. The Air Force realized the information the astronomers desired would have military value. The stationing of observing groups, each with several thousand pounds of equipment, at various isolated points ostensibly is impossible, unless undertaken by an organization having the necessary facilities. The Air Force had the means as well as the need, while the astronomers had the need and experience for gathering eclipse data. The result was a natural symbiosis of the civilian scientists and the military.

The two main cooperating universities in the solar eclipse project were Ohio State University, Columbus, Ohio, and Georgetown University, Washington, D. C. The latter handled the observations obtained by the photoelectric method. A photoelectric group was at each of the seventeen sites. The observers were recruited from various universities and amateur astronomer organizations. All were under the direction of Rev. Francis J. Heyden, S.J., director of the Georgetown College Observatory, and widely recognized as an eclipse expert. The final reduction of the photoelectric data is being performed at Georgetown University.

The method for determining mid-totality is to record simultaneously the light intensity curve of the eclipsed sun and the radio time signals from WWV, all on the same piece of recording tape with a dual pen recorder. Where it was possible, all the sites used the time signal from the National Bureau of Standards WWV transmitter so that there would be an absolute time scale for comparison of the various tapes. Had the time signals suddenly and unexpectedly faded or perhaps not have been received at all during the eclipse, the light curve itself would have been useless. The probability of such an occurrence is not small, because the WWV transmitter is several thousand miles from most of the sites. It was deemed absolutely necessary to provide substitute time signals so that any anomalous or transient condition of the ionosphere would not vitiate the results of the entire project.

Many of the sites were supplied with specially designed crystal clocks which could be calibrated to within 0.001 second of the WWV signals prior to and following the eclipse, at times of favorable radio reception. The crystal supplying the operating frequency for the clock was contained in a temperature controlled chamber. The drift rate was found to be only several thousandths of a second per day, and relatively constant from day to day. The crystal clocks were specially designed by the Ernst Horrman Laboratories, Williams Bay, Wisconsin. These were not available for all the sites, and ship's chronometers were furnished to the remaining ones. The crystal clock or chronometer signals were simultaneously recorded with the WWV signals.

Further measures were taken to assure radio reception of time signals. Several Air Force Communications transmitters re-broadcasted the National Bureau of Standards time signals. A transmitter in the Azores beamed the re-broadcast to the northern sites, and one in North Africa served the site in Iran. However, some observers had to rely on substitute signals from Greenwich in England or Motula in Sweden. On the morning of the eclipse, all of these time signals were compared with the U. S. Naval Observatory's master clocks in Washington, D. C. by Dr. Markowitz. Regardless of what signal a site used, it could later be reduced to the same clock in Washington.

The mechanism for recording the time signals consisted of a communications receiver and a thyratron pulse amplifier that filtered out every signal but the 1000 cycle per second WWV signal. Nevertheless, static was a problem, and often completely masked a loud WWV signal.

The photoelectric signal of the sun's intensity was obtained from an ordinary prototube similar to the type used in sound motion picture projectors. The voltage was amplified before being recorded. The light of the sun was not recorded for the entire eclipse because the variation in brightness between the full sun and the eclipsed sun is over 100,000 to 1. The rate of change of the light intensity is very small during most of the eclipse. It is only during the few minutes preceding second contact (beginning of totality) and the few minutes following third contact (end of totality) that observations are practical. During these times the intensity of the sun changes very rapidly. The photometer was equipped with several neutral density filters that could be quickly interchanged to compensate for the wide variation in light intensity. Observations were generally taken for approximately sixteen minutes, with totality occurring during the middle of the tape.

Most of the groups were on site for approximately two weeks. The equipment could have been set up and

put into operation in a day's time. The entire success of the project, however, depended upon the sixteen minutes that observations were taken. Everything had to be in perfect order, for there could not be a second chance. Many of the sites experienced several electronic failures prior to the eclipse. The crystal clocks and chronometers had to be calibrated for at least four days. In general, the groups were kept busy at the site during most of the two weeks preceding the eclipse.

The Air Force established sites at James Bay; Knob Lake, Labrador; northern Labrador; Greenland; the Faeroe and Shetland Islands; Norway; Sweden; and Iran. The personnel at the northernmost site in Labrador consisted of R. F. Kemper, R. L. Scherer, A. L. Ott, and the writer, all from Pittsburgh. The group departed on June 6, 1954, for Westover A.F.B., Massachusetts. From there we were flown to Goose Bay A.F.B., Labrador. The group was detained there for about a week while the Air Force transported the equipment to the sites. There were five sites to be established in Labrador, and the task was not an easy one.

Most of the ground was covered with snow and the lakes were still frozen in early June. Planes equipped with skis were impractical because the snow cover and the ice were thin. Eskimos had been assigned the task of transporting some of the equipment short distances, but they apparently had been hindered by adverse weather. It was necessary to use helicopters for those sites not near lakes or the sea because the terrain of Labrador is of glacial origin and quite irregular, making it impossible for a land-based plane to land except on a man-made airstrip. Helicopters have a short range, and special provisions were necessary for their use in an uninhabited area several hundred miles from Goose Bay A.F.B. To further complicate matters, some of the natives in their uncivilized innocence removed the parachute cloth site markers from several of the sites, making it virtually impossible for aircraft to locate the correct spot. Despite the difficulties, the 6615th Air Squadron established the five Labrador sites and transported the personnel to them in one week's time.

The Pittsburgh group was flown to Saglek Air Strip near the northern tip of Labrador, and then transported by helicopter forty miles south to the designated site. The group was set down on a rocky plateau near Napartukh Bay at 4:30 P. M. on June 15. Surrounding them were ten packing crates containing equipment, camping supplies, and a three weeks' supply of C-Rations for five men (the group had been joined by A/1C David Ward). A cursory examination of the packing list revealed that the crates contained everything essential, including such articles as insect repellent, double sleeping bags, and slide rules. The immediate task that faced the group was to erect the tents and set up camp before darkness. Ironically, at that time of the year it is never so dark that more than a few bright stars can be seen from Napartukh Bay, latitude 58° N.

TENT EXPANDED by helicopter wind as the "whirly bird" leaves for a nearby eclipse site.

The camp site was favorably situated on dry ground about one mile from the sea. Plenty of fresh water was supplied by melting snow fields. The very rocky ground supported the growth of only grass, small plants, and moss. There was not a tree within ten miles, nor an Eskimo within fifteen. The landscape was barren but impressive. The absence of trees and the clear atmosphere combined to create an illusion of faraway points being very close at hand.

Hunting was prohibited because the natural game was the Eskimo's only source of food. However, the only animals we saw in the sixteen days on site were birds and one lone seal. The presence of large numbers of mosquitoes created the only camping discomfort. The mosquitoes seemed to be a biological anomaly. They approached mathematical "infinity" in number, and their size was prodigious. The puzzling fact concerning their existence was the problem of their food supply. Since other land mammals had not been seen, the eclipse group became convinced that their departure would make mosquitoes extinct near Napartukh Bay.

In regard to the scientific equipment, the group had much to keep them occupied. The radio transmitter could be put into operation only after obtaining some spare parts. The crystal clock motor and chronometer developed troubles and had to be sent out for repair. Fortunately, the helicopters arrived every other day, providing transportation for the equipment needing repairs, and making mail and supply deliveries. The helicopters also delivered the fuel for the two gasoline driven 110 volt generators.

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The Outlook on Insecticide-Resistant House Flies

• By Ralph B. March, Robert L. Metcalf and Lawrence L. Lewallen
DEPARTMENT OF ENTOMOLOGY, UNIVERSITY OF CALIFORNIA, CITRUS EXPERIMENT STATION, RIVERSIDE, CALIFORNIA

The problem of fly control is receiving patient and prolonged study at the University of California. Some promising results have already been obtained.

A trend toward a decrease in resistance to the popular chlorinated hydrocarbon insecticides has been detected. The pyrethrins and the organic phosphates have certain special advantages. New techniques have been devised and new insecticides developed that provide a highly desirable residual effectiveness for several weeks.

On the whole, an encouraging report.

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Because of its favorable climate which permits nearly year-round breeding of house flies, Southern California was one of the first areas in the United States in which this fly developed pronounced insecticide resistance. In most situations over the past seven years, wild house-fly populations have become so highly resistant to DDT, DDD, methoxychlor, lindane, chlordane, dieldrin and other insecticides that their use is impracticable for satisfactory residual fly control.

Our studies have been directed against many aspects of this problem including studies of the fundamental physiological and biochemical bases of resistance, the mechanisms of development of resistance and its inheritance and the development of effective insecticides and their application for field use. Some of the results of our more recent investigations and the present outlook for the future are briefly summarized here.

One of the questions of major practical importance concerns the stability of resistance and whether or not resistant strains will revert to more susceptible strains after insecticides against which resistance has developed are no longer used in control programs. Field collected resistant strains which have been reared in the laboratory without contact with insecticides for five or six years, show about the same levels of susceptibility to DDT as the non-resistant laboratory strain. Although the majority of individual flies in these strains are susceptible, about one per cent of the flies are still highly resistant and they are able to form the nuclei for rapid reselection of highly resistant populations.

In the field the picture has been more complicated due to continued selection pressure from substitute insecticides. For the past two years however, we have detected marked decreases in the average levels of field resistance to DDT, methoxychlor and lindane. These decreases appear to be correlated with the reduction in applications of residual sprays. They are not generally of sufficient magnitude as yet, however, so that DDT, lindane and methoxychlor would be completely re-effective. Studies of this nature are enabling us to observe the development of resistance in reverse and they suggest that we may be able to use these insecticides effectively again, if a rotational or combination control program can be designed which will prevent or at least delay the redevelopment of resistance.

Laboratory studies of the development of resistance by selection of successive generations with increasing amounts of insecticides have resulted in the development of high levels of resistance with all the compounds investigated so far, except pyrethrins and the organic phosphates. For example, over one hundred and twenty generations have been selected with parathion, resulting in only a five- to ten-fold increase in tolerance compared to thousand-fold tolerances selected with other insecticides such as DDT, lindane, methoxychlor, etc. This increase in tolerance was accomplished in the first thirty generations of selection and has remained relatively constant from that time.

Studies of other flies co-inhabiting locations where house flies have developed high levels of resistance, have not disclosed any significant resistance to DDT, lindane, methoxychlor, dieldrin and other insecticides in field collected strains of the false stable fly, *Muscina stabulans* (Fall.), secondary screw worm, *Callitroga macellaria* (F.), black blow fly, *Phormia regina* (Meig.), green bottle fly, *Phaenicia sericata* (Meig.) or little house fly, *Fannia canicularis* (Linn.). After selection of a strain of the black blow fly with lindane for over forty generations, no increase in tolerance was effected. Such studies are very encouraging for they indicate that resistance is characteristic of the insect species rather than the insecticide and that many species may not have the capability of becoming resistant to certain insecticides. The failure to develop house-fly resistance to the organic phosphate insecticides may indicate that they are a group of compounds against which the house fly is unable to develop high levels of resistance as it has against the chlorinated hydrocarbon insecticides.

On the basis of the failures of the past few years, it would appear that the application of residual insecticides for house-fly control has little promise for the future. Since from past experiences the effectiveness of such treatments in supplementing good sanitation practices is obvious when at their best, our major efforts have been directed toward developing new insecticides for residual fly control. Based on our failures to select resistant strains with the organic phosphates, we have been searching for the past few years for suitable compounds of this type exhibiting low

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How to Attain Great Age and Not Become Old

• **By Paul Walden**

GAMMERTINGEN—TÜBINGEN, GERMANY (Translated by R. E. Oesper, University of Cincinnati)

This article merits your full attention.

It was written by a world famous chemist who has reached the great age of 91 years but who has never become old. We are grateful to Dr. Oesper for making his translation available to us.

Dr. Walden considers why living creatures become old. He relates man's many attempts to find an "elixir of life." Pointing out that many prominent chemists have died in their 50's, he asks if these men have lived in conformity with Nature. Are the physical and mental consequences of chemical work necessarily so exhausting that premature death is to be expected? What can be done about the situation?

Here you will find provocative answers to these questions and sound advice that others, as well as chemists, will do well to heed.

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I. The Search for the "Elixir of Life"

The age-old dreams of man include the paradox: "attain high age and yet remain young." This is to say, how can one live many years and yet not experience a decline of the vigor and productive capacity that characterize the prime years.

Five thousand years ago it was recorded that Gilgamesh, the legandary king of Babylon, set forth to seek the "herb of immortality." Although it is stated in Genesis that Methuselah lived 969 years, the Psalmist found it more realistic to state a limit to the lifespan of the ordinary man. "The days of our years are three score and ten; and if by reason of strength they be fourscore years, yet is their strength labor and sorrow, for it is soon cut off and we fly away." Here the bounds and content of the useful life are standardized, as it were.

Millennia succeed each other; hardship and labor, misery and sickness are the faithful companions of man, who raises complaints to high heaven about this "earthly vale of tears." Yet the desire for a long life has always been real, it is as though an inner voice reminds man of his immortality. Like Gilgamesh, man indefatigably seeks means to lengthen his life, he tries to recapture his youth. During the Middle Ages and even much later, certain alchemists boasted that they possessed "the elixir of life"; as early as 1540, the Italian engineer-chemist Biringuccio stated ironically that even though the alchemists had imprisoned God in a glass vessel they nonetheless died like ordinary people.

However, this belief and hope withstood all scoffers. As late as the close of the so-called age of enlightenment, some of the princely courts of Europe entertained the alchemist Count Saint Germain, who claimed to be several thousand years old and openly boasted that he had personally known Christ and the Apostles. The wonderful effectiveness of his rejuvenating agent, which incidentally was to be had for a price, was demonstrated by the case of a very old woman, a vain creature from the Orient, who having taken an overdose found to her great surprise and chagrin that she had turned into a little girl! At about this same time, the well known Berlin professor, C. W. Hufeland (1762-1836), probably the most eminent practical physician of the time in Germany, published his *Makrobiotik oder die Kunst das menschliche Leben zu verlangern.*

* * *

PAUL WALDEN, world famous chemist, was born in the Czarist province of Livonia, July 14, 1863. After studying under Ostwald and Baeyer, he taught in the Riga Polytechnicum and carried on research in synthetic organic chemistry and physico-chemical measurements. Scientists know of the Ostwald-Walden valence rule, the Walden inversion, and the Walden viscosity rule. As Rector of the Riga school he moved it to Moscow during World War I and kept it in operation through the War and during the Revolution of 1917.

In 1919, he fled to Germany where he taught at the University of Rostock until he "retired" in 1934. He published many scientific papers, and several important books, and served as guest lecturer at other important universities, including Cornell University (1927-28).

During World War II his home and his 10,000 volume library were destroyed by an incendiary bomb. In his later years Dr. Walden's interest turned to chemical history. He is now, at 91, guest professor and lecturer in the history of science at the University of Tübigen.

Dr. Oesper says of him: "His dramatic and painful experiences have impressed upon him the ephemeral character of material possessions, their transient value, and their faithlessness to their owner. To him, the most lasting possession is the feeling of satisfaction that comes from a long lifetime of mental efficiency, which stems from the astonishing adaptability of the organism and the defensive powers of the mind against the hindering influences of environment. He firmly believes that each individual can remain the master of his fate if he is given free opportunity to apply his spiritual-mental energies."

This treatise on the prolongation of human life was translated into many languages, but despite his expert knowledge of the "art" and "rules of living," the author died at a mere 74.

About a century later, medical men and physiologists began the modern method of rejuvenating the aged, and infused the age-old hopes with new life. In 1889, the French physician, Brown-Séquard, then 72, began to inject himself with extracts of internal reproductive glands. This was the start of the now well known organotherapy, which in essence is a revival of an old notion contained in folk medicine, namely that "like cures like." In other words, heart cures heart, kidney cures kidney, and so on. The ailment afflicting a particular organ was thought to be due to the lack of some material peculiar to the organ, and consequently supplying this substance was a logical treatment. The great Paracelsus (1493-1541), was an adherent of the related "doctrine of signatures" in which, for instance, a scarlet cloth was applied to a patient suffering from scarlet fever. (The traditional curative powers of red flannel probably stem from this same type of thinking.) Brown-Séquard actually believed that the injections had brought him definite improvement (auto-suggestion doubtless played a role here) but he died five years later. His successors were not able to achieve either rejuvenation or prolongation of life, and accordingly more strenuous measures were tried: direct transplants of animal glands into the human body. This expensive operation was practiced in Paris by S. Voronoff from about 1926 to his death (at 81) in 1947. It brought high hope and likewise sore disappointments, not only in the case of the experimental monkeys but also with human castrates and elderly men. His countryman and contemporary in Kiev, Alexander Bogomoletz, went back to serum injections. His "wonder serum," prepared from the bone marrow of fresh cadavers, was supposed to protect the most important human tissues against hardening. He promised to prolong life to 120-150 years, but he himself died in 1946 at 65. Other prominent names in this connection include Poehl in St. Petersburg, Steinach and Doppler in Vienna, Bardach in Paris. In toto, sexual hormone therapy and such well publicized dreams as rejuvenation by means of hens' eggs, came to nothing; the cartoonists and the skeptics had a field day.

These fruitless attacks on "aging" and the vain attempts to "recover youth" demonstrate that the methods were based on false premises and that inadequate means were used, especially those involving the sexual hormones. It is a delusive generalization to connect aging and senescene, causally and basically, with failure of the glandular activity. Rather, the latter should be viewed as a consequence and attendant phenomenon of aging. Accordingly, when employed for this purpose, the administration of these hormones, in the form of animal extracts and chemical preparations, is predoomed to failure. These sex hormones function merely as biocatalysts, i.e., they stimulate and release quiescent forces already present; they also accelerate sluggish reactions but they cannot revivify expired powers. In addition, it is a perverse philosophy to identify Promethean man—backwards—with the apes and to attempt to reendow him with youthful creative powers by means of transplanted monkey glands.

II. Life and Matter

Modern materialists explain life as the chemical transformation of inorganic carbon (carbon dioxide, etc.), through the medium of plant growth, into compounds of organic carbon. However, the organic compounds preserved in glass containers in a chemist's collection are obviously not life, but merely its material residence. In the speculations of the quantum physicists, life appeared on earth as a "blind chance," as a protein molecule capable of multiplication, i.e., as a "protein life" stemming from inorganic materials. However, in view of the highly specific and complicated structure of protein, this idea is rejected by the high molecular chemists. Life, along with soul and mind, is a *unicum*, a miraculous achievement of creation, which man cannot explain. Instead, he should observe it with very special interest and protect it with all means at his disposal.

What is "aging" really, and why do living creatures "grow old"? Are those physiologists who assert that a life span of 200 to 300 years is a proven possibility to be regarded as crackpots? The possibility may exist, but certainly all that lives ages. In fact, this process is not confined to the animate world. Inanimate systems are also subject to aging: alloys, steel rails, rubber, catalysts, are familiar instances. Machines grow old; they undergo changes in form and structure, they rust and corrode, the material wears away. Likewise, the living machine is attacked by the processes of wasting away, exhaustion and degeneration of the tissues, hardening or calcification of the circulatory vessels, etc. Considerable damage also is probably caused through internal poisoning by decomposition toxins: (ptomaines, Selmi, 1870); bacterial poisons (Metchnikoff, 1884, on); intestinal vermiculi (Weber, 1953), whose growth is alleged to be favored by cosmic and radioactive radiations, with consequent stepped-up production of their poison and hence accelerated aging and mortality of the host organism.

The chemical and physical architecture (structure, form) and the specific chemical behavior of the organic materials composing the living organism are of decisive significance to the origin and causes of aging. Life and creative nature are distinguished by achieving their wonders through very high molecular compounds, which occur mostly in the noncrystalline state and as colloid dispersions. These include, above all, the proteins, whose molecular weights or particle masses are 100,000 or more. They occur as extended threadlike molecules (sometimes as spheres) and make up the supporting and sheathing substances (skin, tendons, muscles, arteries, nerves, etc.) as well as the cell contents (plasma). Proteus-like, they readily alter their shapes and behaviors, not only by swelling, formation of networks, and inclusions, but also by precipitation, coagulation, gelatinization, and in response to thermal and mechanical influences.

In contrast to the simple, crystalline low molecular inorganic materials, which are usually quite stable and

exhibit quiescent chemical affinity, this world of organic colloidal high molecular substances presents a continual state of physico-chemical change; in other words, it displays the dynamics of the life processes. These two realms differ strikingly in their methods. The chemical "technologist" deals with a system composed of but few materials that are present in previously determined quantities, and usually subjected to high temperatures and pressures, in capacious stout vessels (autoclaves, cylinders), and under continuously controlled conditions. The "bio" chemist operates quite differently; he presides over a many-component system that is subjected to delicate forces and tender methods. His reaction vessels are the innumerable tiny, fragile cells of the living organism, which operates at a temperature of only 35°C. Remarkably enough, despite the potential great freedom of the chemical processes, they go forward under these conditions, in strict selectivity and within narrow bounds. The chemist who employs hammer and tongs methods ought to look with great respect on the infinitely delicate and complicated accomplishments of his gifted competitor "bios."

From the Fisher Collection of Alchemical and Historical Pictures.

THIS 16TH CENTURY engraving by Dürer suggests that the alchemist stopped at literally nothing in his strange and sometime nauseating experiments to reach the Elixir of Life and perpetual youth. Actual eggs from all types of fowl were sought as ingredients. Ben Johnson's play, "The Alchemist," speaks of eggs as differing from chickens no more than other metals differ from gold. And the "Philosopher's Egg," an oval glass vessel with a neck capable of being sealed, played a large part in alchemical writings and experiments on longevity and transmutation.

III. Aging and Senescence Among Eminent Scientists

Prosperity gratefully plaits laurel wreaths for the brows of the great men and in some cases raises statues to them, from whose pedestal they, as "victors," may look down, now freed from the physical ailments and impediments of old age, and symbolizing, in a sense, the legendary elixir of life and eternal youth. However, another picture unfolds when the later generations make a careful study of the biographies and memoirs of eminent experimental scientists. It then becomes apparent that although Nature has indeed showered gifts on her favorites she also takes from them a heavy toll, usually from their reservoir of vital forces. Examples illustrating this important fact are easy to find; exhaustion of the vital energies and resulting premature death are all too common among prominent scientists, especially chemists.

The rapid rise of chemistry began in the late 18th century. As a rule, its greatest figures did not attain high age. Lomonosov died at 54; Scheele (44); Bergman (49); Richter (45); Lowitz (47); Wenzel (53). The record in the 19th century is much the same: Davy (51); von Grotthus (37); Maxwell (48); Hertz (37); all prominent in the founding of electrochemistry and the theory of electricity. Similarly, among the pioneers in thermochemistry and heat theory: Carnot (36); Dulong (53); Petit (29); Hess (48). The founding of organic (structural- and stereo-chemistry) took its toll in the early deaths of Gerhardt (40); Laurent (46); Victor Meyer (49, suicide because of intolerable migraine); Werner (53), arterio-sclerosis); van't Hoff (59). Pasteur suffered a stroke and was crippled at 46; Kekulé was afflicted with neurasthenic attacks from 50 on; Liebig manifested serious symptoms from about 47 on and developed a violent distaste for laboratory teaching and experimental research, fields in which he had formerly reveled.

This list from "the heroes' cemetery of chemical research" could be extended down to the present but the data are sufficient to demonstrate the typical *death around the 50th year.* The symptoms of this coming catastrophe are essentially of two kinds: (1) psychological-individual and (2) medical aetiological. In the

first category there appears an insatiable urge to accomplish research, a violent onset of work and consumption of energy, a fixed expectation of success, *in toto;* a one-sided lodging of all interest in a single project, even to the neglect of personal needs and duties. The second category may be divided as to kind and degree: marked susceptibility to fatigue, sudden irruptions of antipathy (approaching even abhorrence) and fear of activities hitherto pursued with enthusiasm (teaching, lecturing, research), nervous collapses, attacks of migraine, serious lapses of memory, insomnia, loss of appetite, paralytic strokes, fatal heart attacks. (As is well known, arteriosclerosis commonly appears after 50.) All of these symptoms are the characteristic manifestations of neurasthenia and neural weakness. Since they have long appeared among eminent experimental scientists and particularly with chemists, the author suggests the collective term "neurasthenia chemicorum." (Similar occupational maladies are common in other lines, for instance, "manager's disease.")

The following discussion will serve to emphasize that these physical and mental consequences are not due to chemistry *per se* nor to a fanatical devotion to chemical research.

IV. Retardation of Senescence and Promotion of Longevity Among Scientists by Radical Changes in Interests

The symptoms given in Part III are clarion warnings given out by the organism, whose strictly ordered equilibrium of building-up and tearing-down in its physiological-biological and psychical-mental functions has been disturbed by excessive one-sided demands and overwork, by undernourishment, and by over-irritation of the nervous system. These signals denote that all is not well in the circulatory system; they are sent out by the nervous system (and the brain) which autonomously or automatically regulate this important life process. It is essential to pay heed to these warnings in good time, and proper countermeasures should be taken at once. Otherwise, a premature senility and/or a physical collapse is almost certain to follow. What should be done to avoid such a result?

The rational precautionary and alleviative measures include: a radical alteration or abandonment of the previous one-sided method of working and living; shunting-out of the over-strained, fatigued, used-up brain centers; and change to other brain regions by taking up entirely new activities and fields of interest.

It is important, likewise, to change the transmission of messages from the psychical-mental personal internal world to another, unoccupied wave length. This change can be accomplished, depending on the individual circumstances, either consciously or subconsciously, and a change of environment (scenery) will be a potent factor in this connection. When Cicero retired to his Tusculum, he was not the first to seek a peaceful scene in which to recuperate, but it is significant that his philosophical essays on human happiness were composed there.

Some two thousand years later, Alexander von Humboldt, noted chemist, teacher, traveller, diplomat, writer, also changed his address permanently; when he died (1859) at the age of 90, he was still working on the conclusion of his 5-volume "Kosmos." Justus Liebig broke down physically and mentally at 49; he left Giessen, the scene of his wonderful career as a teacher and chemist, and accepted a chair at Munich, because he was promised that he could continue his work under less onerous conditions where he would be subject to much less disturbance regarding matters which he had come to believe were not of importance. After the move, he wrote to his mother: "I sleep the whole night through; at evening I can eat like any healthy man, even things which (at Giessen) I have not been able to endure for many years." His activity at Munich continued for no less than 21 years and he enjoyed good health through most of this extra time. His successor at Munich, the famous Adolf von Bayer, after the finish of his indigo synthesis (1883), at the age of 48 changed from technical dyestuff research to purely scientific problems and worked for 32 years more. He died at 82. His successor, R. Willstätter (d. 1942) relinquished his professorship at 52 and continued his scientific activity 18 years longer. Wilhelm Ostwald, the founder of physical chemical training courses, voluntarily resigned his chair at Leipsic at 53. The next 26 years were devoted to energetics, world peace, international language, color theory, etc. Similarly, timely shifts to other fields of mental activity doubtless greatly lengthened the lives and active careers of such prominent persons as: M. Chevreul (died 1889 at 103); Oskar Loew (1941 at 97); J. W. Hittorf (90); Max Planck (89); H. Le Chatelier (86); R. W. Bunsen (88); J. B. Dumas, S. Cannizzaro, and Ira Remsen (84); F. Wöhler, M. Berthelot, and A. Williamson (80).

The following examples demonstrate that executives and captains of industry need not die prematurely. James Watt, improver of the steam engine, chemist, engineer, lived to 83; James Muspratt, founder of England's large scale chemical industry and technical writer, died at 93; Thomas Edison, Henry Ford (auto king, pacifist, social reformer), Ernest Solvay (creator of the soda industry, sociologist, founder of the Solvay Institutes) lived to 84; J. D. Rockefeller died at 98. This list of "great oldsters" can well be brought to a close by the many-sided G. B. Shaw, who reached 97. They all were master of the art of attaining advanced years and remaining productive. They carried the "elixir of life" within themselves.

V. Conclusion

This historical survey may perhaps be supplemented by the statement: "To attain advanced age is not difficult; it is merely necessary to live in conformity with the laws of Nature." In other words, "Nature is the master of all masters." Life, the evergreen magic tree of Nature, has been taken over by her and she manages it as a strictly regulated unification of all the bearers of life on the earth. Nature is a master of "self-help"; she creates life in the delicately constructed system of substances and in rhythms (between winter and summer, day and night, building-up and tearing-down, labor and rest); she creates life carefully in peaceful fashion, without bustle, hurry, or strife; she produces it from tender materials and without much expenditure of

(Continued on Page 24)

The Chemist's "Magna Charta"

• By Rev. Bernard A. Fiekers, S.J., Ph.D., *(Clark University)*
CHAIRMAN, DEPARTMENT OF CHEMISTRY, COLLEGE OF THE HOLY CROSS, WORCESTER, MASSACHUSETTS

Is this the world's largest Periodic Table of the Chemical Elements?

Extending over an eight-by-eighteen foot area, it may well be.

A teaching tool that is not only unusual but useful and decorative as well. Students who face it every day will begin soon to appreciate the values inherent in this atomic classification. One who understands the Table, its values and its limitations, bases his knowledge of chemistry on a sound foundation.

●

What the Bill of Rights is to the Common Man, the Koran to the Moslem, and the Sermon on the Mount to the Christian, that the periodic table of the chemical elements is to the chemist. For, it is his principle and foundation in which all known developments in his science are synopsized, from which new ones are prophesied and to which revolutionary ideas are ultimately referred. It is the chemist's alphabet—his *alpha and omega*, his chemical testament, his table of sums and products, his very Constitution and all of its Amendments.

The recent construction of such a periodic table on wall tile in the larger chemistry lecture hall of the College of the Holy Cross provides a monument to the organized teaching of chemistry at the College for over half a century. Its eight by eighteen foot dimensions encompass the chemistry professor's ideal. This mural does credit to the concept developed by Doebereiner, Newlands, Meyer, Mendeleef and their successors. May it survive for centennials!

What may be included among the world's largest productions of this kind is mounted over the blackboard on the two-storied wall in the lecture hall for over two hundred students to see and study. With a good deal of color to it, and well lighted, it fits gracefully into its surroundings. Its functional beauty impresses the mid-twentieth century student of chemistry with the belief that the atom is here to stay. He is brought face to face with its full symbolism in his daily classes. If he has any misgivings about its destructive power in modern times, he can join this belief with faith in *the sign that conquers*. For, in the open spaces at the upper levels of this chart there stands the Cross itself, planted on the element cobalt (Co), thirty by twenty-two inches, and two and a half inches slender. At the very base of the chart, beneath this cross, the dreaded element plutonium (Pu) is located—an eventual conquest for *the sign of every Crusader*. In more than one sense it is then a *Magna Charta* to liberate man from his fear of the invisible atom.

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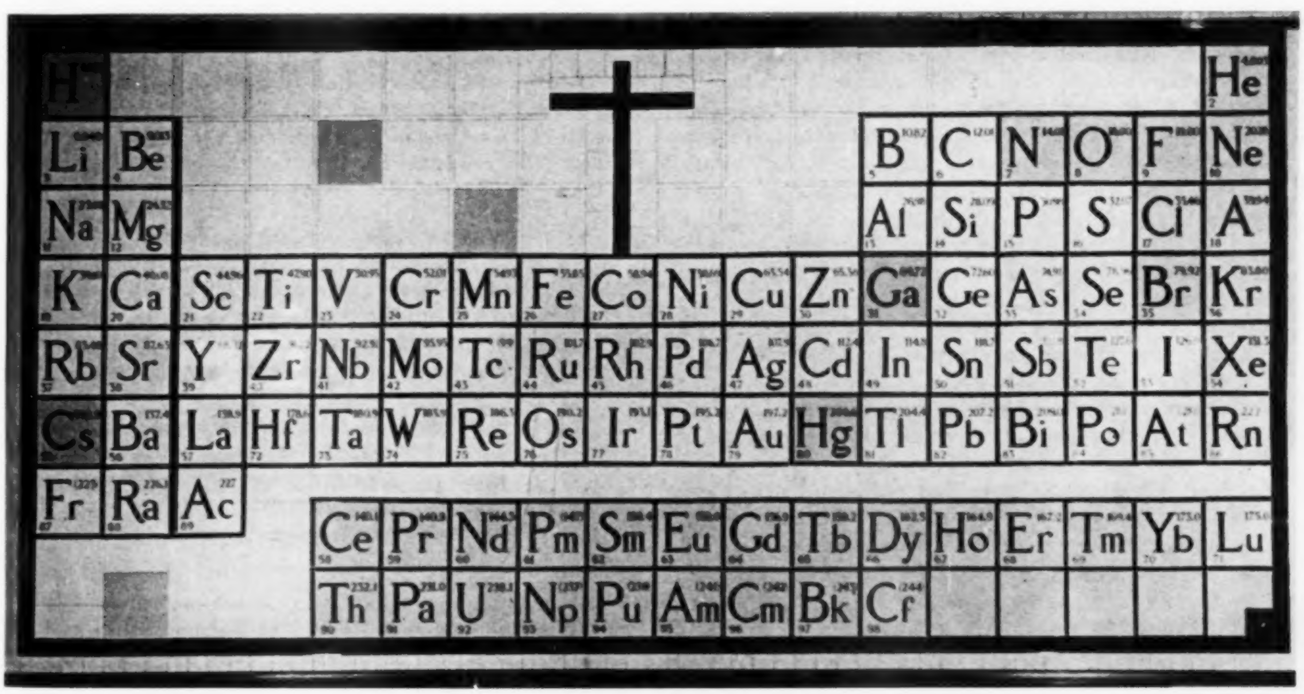

THE CHEMIST'S MAGNA CHARTA

After a Hurricane — A Bomb Attack?

• From The Keystone Defender

The devastation wrought by hurricane Hazel as it swept through the eastern states recently posed many questions of safe procedure for those affected. The situation is comparable to that following an A-bomb attack.

The January, 1955, issue of "The Keystone Defender" gives common-sense answers to some of the more important questions. That publication graciously permits us to give them wider circulation.

Here is important material for class discussion and instruction.

●

HOUSEHOLDERS:

Do you know?

Where to find safe water, if your taps don't run?

How to turn off your own water service valve?

How to purify water if you have to drink from an uncertain source?

What foods to store, and how to prepare them?

What to do with frozen foods?

You and your family could get along quite a while without food, if necessary, but you must have safe water to drink. Interruption of this vital service as a result of enemy attack is not the only thing that could happen to your home water supply, though it is the one most people think about . . . if they think at all. It should also be considered, however, that the water might continue to run, but be unsafe as a result of leaking sewage, poisonous chemicals, radioactive materials, or even disease-bearing organisms from biological warfare attacks. You might need to know how to turn off your water valves to prevent such contamination from entering your house, following radio information that water supplies had been found unsafe.

Let us see how much fluid the average family usually has on hand in the normal course of events. Most families have some milk in the refrigerator, some bottles of Coca-Cola, fruit drinks, soda water, or ginger ale. In addition, most of us generally have some fruit juice or cans of water-packed fruit or vegetables. In addition, you have ice-trays, and 40-80 gallons of water in your hot-water boiler which can be used for drinking if you run short. It may look rusty and unattractive, but this will not hurt you. Strain it through a cloth if you feel that it is worth the trouble. That will clear it of most sediment. Even the water in your toilet tanks can be drunk if necessary.

Some families normally keep glass jugs of water in their refrigerators, in order to have cold drinking water. This is a good habit for all to cultivate. Each householder should figure on a minimum of one gallon of drinking fluid for each member of the family; children under 3 should have an extra gallon per child. This should last you for three days.

Turning Off Your Valve

If word comes through that the water supply is contaminated in your area, or if your own pipes were broken and flooding your cellar, or if you were asked to turn off your own water in order to maintain fire-fighting pressure in the city, would you know how to do it?

The water service valve is usually located in the basement, or just outside the house, often near an outside faucet. Sometimes it is in a curb box. Not only you, but all members of your family should know where to find the shut-off valve that controls the water service to your house. The valve should work freely. If it requires a wrench, the wrench should be kept available.

If your taps do not flow following an attack, turn off all the water outlets, including taps and faucets, valves on pipes supplying float-controlled equipment such as flush-toilets, air-cooling equipment, and heating equipment.

Turn off the gas or electricity that supplies your hot-water heater after closing your home water service valve, or when your water supply is interrupted for any reason. If you do NOT do this, and the limited supply of water remaining in your hot-water storage tank continues to be heated, an explosion could occur.

Don't telephone anyone to report your lack of water. The officials will know about it. Telephone lines will be vitally needed for more serious CD emergencies.

How to Purify Water Easily

Boiling

Most water can be drunk safely if it has been boiled for 5 to 10 minutes. It will taste less flat if you add a pinch of salt after boiling, or aerate it by pouring it from one container to another for a few minutes.

Chlorination

You may have no gas or electric power and so not be able to boil water. In that case, any household bleach, such as chlorox or any similar bleach containing hypochlorite (read the label) may be used. Depending on the strength of the solution (given on the label) the amount necessary varies from ¼ teaspoon to ten drops per quart, or from ¼ teaspoon to 2 teaspoons for a five gallon container. After adding the bleach and stirring, let it stand for 30 minutes. It should taste or smell of chlorine. That is your safety sign. While unpleasant, it is not harmful, and it is the best way to be sure you have added enough.

Iodine

If you have no household bleach on hand, but do have iodine, use that. Add 2 or 3 drops to a quart of water. That, too, should be allowed to stand for half an hour.

(Continued on Page 25)

Fluorescent Lamps and Their Applications

• By Robert L. Zahour, E. E.
LAMP DIVISION, WESTINGHOUSE ELECTRIC CORPORATION, BLOOMFIELD, NEW JERSEY

Late information about a modern convenience that science teachers should have, especially teachers of physics.

Written by an expert, this article explains the construction of fluorescent lamps and their possible variations, the long-life cold cathode and the instant-start hot cathode, and the modifications in color that are possible even in white lamps.

Here you may also learn about starting switches, types of ballast, and many other interesting things including the mysterious phosphors that convert short-wave energy into light.

The fluorescent lamp is simply a glass tubular bulb with electrodes sealed into each end, full of mercury vapor at low pressure with a small amount of argon (for starting), and coated on the inside with fluorescent powders which give off light when activated by ultraviolet energy. When the proper voltage is impressed across the electrodes, a flow of electrons is driven between them. As these electrons speed through the tube, they collide with the mercury atoms, causing a state of excitation which produces shortwave ultraviolet radiation (2537 Angstroms). The fluorescent powders commonly known as phosphors, absorb this invisible energy and radiate visible light, (Fig. 1.).

This sounds simple enough, and it would be if it were not for the sensitivity of the fluorescent lamp. To get the lamp to operate at economical efficiencies has taxed the ingenuity of engineers for many years, and has led to extensive investigations of every component of the fluorescent. One of the first, and most important, components to come in for research was the electrode, partly because something was already known about electrode materials, but mostly because the electrode is perhaps the most important factor in obtaining long lamp life.

Two principal types of electrodes are employed in fluorescent lamps, the coated coiled-coil tungsten wire, and the inside-coated cylindrical metal tube, (Fig. 2.).

The coiled tungsten wire type of electrode is coated with an emission material of barium and strontium oxide which gives off electrons when heated. The process is called thermionic emission because the electrons are emitted more as a result of the heat developed than of the voltage applied. A hot spot is created on the cathode at the point where the mercury arc strikes, and a continuous stream of electrons is produced. This type of operation is characteristic of what is known as the "hot cathode" lamp. As originally developed it required a preheating of the cathodes to produce the necessary electrons to strike the arc. By the use of a higher impressed voltage it can also be made to start instantly, without preheating. Recently, a new system was developed, called "rapid start." This system starts lamps within one second and eliminates starters because a continuous preheating current flows through the electrode coil.

The coated, iron cylindrical-tube electrode, commonly known as the "cold cathode," also relies on the application of a high voltage to pull electrons from the unheated cathode and provide instant starting. The arc terminates on the entire cylinder, instead of at a particular point, as on the coiled wire or hot cathode. Thus the heat is generated over a larger area and the cathode does not reach as high a temperature at any one place; hence the name "cold cathode." Because of the lower temperature and the lack of thermionic emission, a higher voltage is necessary to maintain the electron supply. The potential drop at a cold cathode is about five times that at a hot cathode, and consequently the cathode wattage loss is much greater and the lamp is less efficient. The cold cathode does however, have a longer life, especially where the lamp is subjected to frequent starting, as on flashing circuits.

Another lamp component that is tremendously important in lamp efficiency is the phosphor. Very little is known about the basic nature of any phosphor. Engineers and scientists have learned enough to permit them to apply phosphors to a considerable extent. The reasons for phosphor behavior, however, remain largely mysterious.

The fluorescent and phosphorescent materials most

FIGURE 5. Students see better and feel better when the classroom is well lighted.

commonly used in paints, dyes, and plastics are excited by longwave ultraviolet in the neighborhood of 3650 Angstroms. Fluorescent lamps employ compounds of another type activated by 2537-Angstrom ultraviolet, which is the wavelength most efficiently generated by a low-pressure mercury arc (Table A). The phosphors

TABLE A

Phosphor	Color of Fluorescence
Zinc Silicate	Green
Calcium Tungstate	Blue
Cadmium Borate	Pink
Calcium Halo Phosphate	Whites of Various Color Temps.
Magnesium Tungstate	Bluish White

selected for use in lamps are chosen because they are efficient converters of this shortwave energy into light, and because they are stable compounds which maintain their light output at a reasonable level throughout the life of the lamp.

The color produced depends on the chemical composition of the phosphors. The Standard-Cool-White, Standard-Warm-White and White lamp colors are obtained by controlled variations of a single phosphor, and the De Luxe-Cool-White, De Luxe Warm-White, Daylight, and Soft-White colors by a blend of phosphors. Green, blue, and pink lamps use single phosphors, while gold and red color lamps have a colored coating applied to the inner surface of the bulb, in addition to the phosphor.

Another phosphor known as 360BL is an efficient source of so-called near ultraviolet, that is, longer wave length ultraviolet. The phosphor has its maximum energy output at about 3650 Angstroms. Lamps made with this phosphor produce very little visible radiation, and are intended for use only in activating fluorescent and phosphorescent materials. In other respects 360BL lamps are similar to standard fluorescent lamps.

There are, of course, a great variety of fluorescent lamps. The lamp industry has built up a number-letter nomenclature to designate the various sizes, types, and other characteristics. The fluorescent lamp is generally designated by "Type F" and its diameter is always a multiple of one-eighth inch. Hence, a T-5 lamp (T designates "tubular" bulb shape) is a lamp ⅝ inches in diameter. Fluorescents vary in diameter from T-5 to T-17. The standard line of lamps with preheat

THEORY OF OPERATION

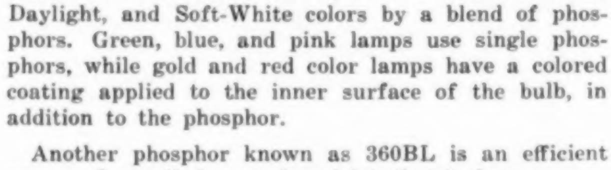

Figure 1.

Cathodes

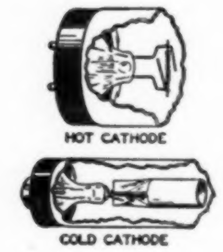

Figure 2.

cathodes vary in length from 6 to 60 inches. Slimline lamps are made in T-6, T-8, and T-12 bulbs, and range up to 96 inches in length. They employ the instant-start type of hot cathode.

The 40-watt T-12 lamp is available with either the preheat, the instant-start or the rapid start cathode. Fluorescent lamps are also made in the form of a half-circle, and a circle. These are known as Circlarc and Circline lamps, respectively, and have the preheat type of cathode, with the exception of the 16 inch Circline which operates on a rapid-start coil.

Like all electric discharge lamps, fluorescent lamps must have an auxiliary transformer or ballast both to limit the current and, in most cases, to provide the

Bases

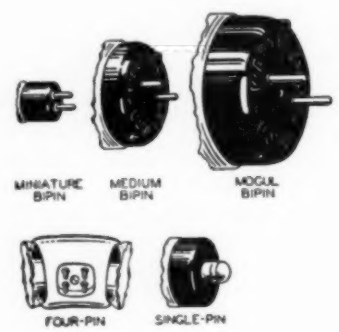

Figure 3.

necessary starting voltage. Each lamp requires a ballast specifically designed for its characteristics, and for the service voltage on which it is to be operated. The chief differences among ballasts is in the range of open-circuit voltages supplied to the lamp. Lamps with preheat cathodes require relatively low starting voltages, not over 200 volts, while 40 watt rapid start lamps start at 300 volts. Hot cathode instant-start and most multiple cold cathode lamps require from 450 to 750 volts while cold cathode lamps operated in series, need considerably higher voltages.

The preheat type of lamp requires a temporary starting circuit through the cathodes. The duration of this flow of current may be controlled manually, but most installations contain automatic switches. Starting

switches may be of the thermal- or the glow-switch type, the latter being in much more common use today.

Circuitry for fluorescents usually depends on type of ballast used. With an ordinary two-lamp ballast, each lamp has a separate reactor, or winding, in the ballast. Also a capacitor is connected in series with one of the reactors (Fig. 4). There are two reasons for this arrangement: better efficiency, and decreased stroboscopic effect. Since fluorescents are operated on a-c, they fluctuate in light output slightly with each cycle. This fluctuation is not noticeable with one lamp but is naturally multiplied by adding other fluorescents whose light outputs fluctuate at the same time. The capacitor in series with the reactor causes the light output of that lamp to fluctuate at a different time during the ordinary cycle, thereby decreasing the stroboscopic effect. This circuitry arrangement also provides for better power utilization and lower wattage losses within the ballast itself.

Instant-Start and Slimline ballasts perform only two of the three functions served by preheat ballasts: they provide the necessary potential to start the lamp, and they limit the arc current. Because of the higher voltages involved, these ballasts are larger than those for starter operation, and the ballast losses are somewhat greater. Slimline ballasts are generally designed for a lamp current of 100, 200, or 300 milliamperes for the T-6 and T-8 bulb lamps, and 200, 425 and 600 milliamperes for T-12 bulb lamps. Like the preheat type of ballast, they are available for single- and for two-lamp operation.

Applications for fluorescents appear unlimited. Their appeal is based on long sought application advantages. Firstly, they provide linear light sources effective in reducing shadows by increasing diffusion of light. Besides, for equal light output, fluorescent lamps are more efficient than the incandescent type and consequently operate much cooler. For example, two 40-watt lamps operating on a two-lamp ballast consume 100 watts and produce 5200 lumens of light, while a 100 watt incandescent lamp develops only 1630 lumens. Furthermore, at 3 hours per start, fluorescent lamps have an average life of 7500 hours or more.

These advantages have opened the way to a wide field of application for fluorescent lamps. They are being used wherever continuous uniform illumination is desired. Fluorescent lighting has an economical advantage in that for a given illumination level, the over-all long range cost of lighting is generally less than the cost for an incandescent system producing the same illumination. High efficiency, low lamp cost, long life and high lumen maintenance make this cost advantage quite evident.

For example, in medium and low bay factory areas, where high levels of illumination are required to reduce accidents and spoilage as well as to increase production, rows of fixtures with fluorescent lamps provide these lighting requirements efficiently and economically.

In stores and supermarkets where sales are dependent on customers' ability to see packaged foods quickly, and to make meats and vegetables appealingly attractive, high levels of illumination have been found advantageous. Rows of fluorescent lighting fixtures with proper shielding direct light onto the display racks and food display areas to create sales appeal.

In classrooms, (Fig. 5), results of studies conducted on students, reveal that they see better and feel better under substantial levels of good quality lighting. For example, a minimum of 30 footcandles in classrooms, and 50 footcandles or more in drafting and sewing rooms is recommended in the ASA Code on School Lighting. To meet these minimum levels, fluorescent lamps in suitable fixtures with proper shielding have been found to be very satisfactory. Be-

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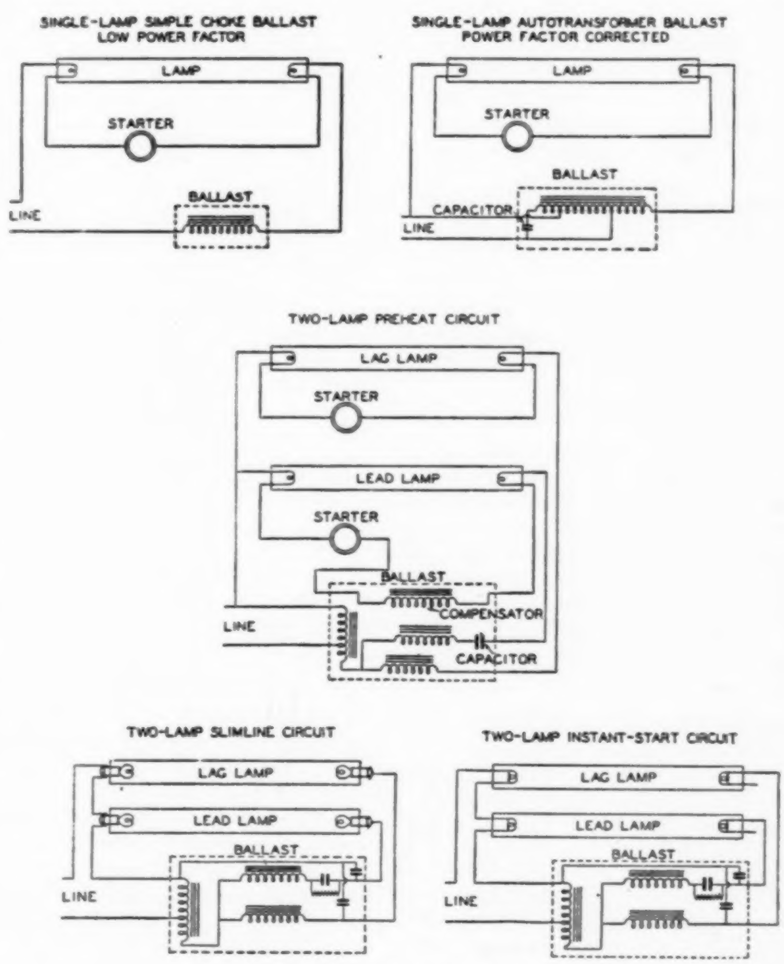


FIGURE 4. Circuits for Fluorescents.

A Bit About Biological Stains

• **By Robert T. Hance, Ph.D.,** *(University of Pennsylvania)*
THE MATHESON COLEMAN & BELL DIVISION, THE MATHESON COMPANY, NORWOOD, OHIO

If "Histology depends upon staining," the histologist should know something of all the materials with which he works, including stains. He can, of course, use a stain without knowing much of its origin, structure, or mode of action, but the broader his knowledge the keener will be his perception and understanding.

This paper should stimulate readers to want to know more about biological stains.

●

Changing the color of man's physical surroundings has been the vogue for more centuries than have left records other than hearsay. Dyes have been used as symbols of social distinction, to gild the lily of human perfection, to hold the mirror up to Nature, for camouflage, and, in general, to render our environment more pleasing and endurable.

Early dyes or stains were found in Nature and were of animal, plant or mineral origin. Not a great deal is known of their chemistry.

The value of dyes for other than decorative purposes did not become apparent until the invention of the microscope in the 17th Century. It seems fitting that its inventor, Leeuwenhoek, was also the first to report to the Royal Society in 1714 the use of a stain (saffron) on razor-sliced sections of muscle fibers. The Fellows of the Royal Society were, apparently, slightly bored with the energetic literary productivity of Leeuwenhoek, to whom they referred as "that curious and inquisitive person." His 1714 letter did not get into print for five years.

Impetus was given to microscopic study with the announcement, in 1840, of Schleiden and Schwann's Cell Theory that all living things are made up of minute units called cells. The finding of new ways to use old stains and the discovery of many new ones focussed attention on the importance of their aid in analyzing microanatomy. While he did not originate the staining of histological preparations, Gerlach's paper published in 1858 on the importance in histology of staining with carmine, is credited with sparking a rapid development of the subject.

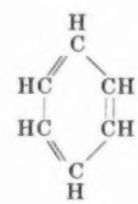
Today, our health is dependent in no small measure on our ability to see, with the aid of stains and the microscope, the variations from the normal in blood and tissue cells that indicate what causes the patient's suffering and what may ease discomfort and prolong life.

The Chemistry of Stains

A great deal is known about the chemistry of modern dyes that is useful in understanding the cause of the color of various compounds, in postulating the reason for their staining activity, and in planning other combinations that may result in new and useful colors. The biologist, who is primarily concerned with highlighting certain structures in his microscopical preparations, need for this purpose not be too much concerned with the details of the chemical activity of stains. However, a little knowledge is said never to hurt anyone. A brief and sketchy outline then of some of the elements of stain chemistry may serve to bring a greater appreciation of the marvels accomplished by the staining of tissues. And it may also serve as a signpost pointing to an era into which we are now moving. Stains and related products may in the future serve not only to indicate micro-anatomical differences but, if we know enough chemistry to interpret, give us clues to physiological activity as well.

Hematoxylin, a natural dye from logwood developed in 1863-65, continues to be one of our most popular dyes. The first of a long series of "aniline" dyes appeared in 1862. The artificial dyes are generally known as "aniline" dyes since the first ones were developed from aniline. A better name, however, for the artificial group would be "coal-tar dyes" for it is from coal derivatives that the greater number of modern dyes are produced. The Germans have received well merited recognition for their yeoman service in producing dyes from coal tar, but it is interesting to note that the first of all synthetic dyes was produced, in 1856, by a 19-year old Englishman, William H. Perkin, while trying to make quinine from aniline.

As with many complex chemicals that have a backbone of carbon atoms, the coal-tar dyes are based on benzene whose six carbon atoms are pictured as bonded together in a ring or hexagon with an hydrogen atom attached to each of the carbons. This is the well known benzene ring:



whose shape is supposed to have resulted as an aftermath of a European beer party in days when the alcoholic content was not supervised by the Law. One of the celebrants was so affected that he saw snakes, which thoughtfully avoided him by putting their tails in their mouths and rolling away. Being a chemist and in a receptive mood, the party goer saw in the snakes' anatomical stunt a solution to a chemical problem that had long been bothering him. He had noted something about the behavior of certain kinds of carbon compounds that seemed contrary to the common idea that the carbon atoms were attached to each other in

a sort of chemical Conga line. The reptilian wheels rolling away gave a new picture—the Conga line became a "Ring around Rosie." A new and extremely useful concept of molecular architecture was born.

This circlet of carbon atoms, by changing its hydrogen atoms for other chemical units or aggregates, can form innumerable compounds ranging from the relatively simple to the highly complex. The non-chemist may be able to picture these possibilities better by remembering the vast number of words that result from varying combinations of only 26 letters, or from the unions of groups of these letters. As each combination of letters has its own meaning, so each particular gathering of atoms or atomic aggregates about the basic benzene ring has specific physical and chemical properties. Some of these groupings may show color that can coat or cover but may not have the ability to fix the color on or in other objects. Other unions of atomic groups are able to stain by actually uniting with, not merely coating, material such as fabrics, leather, and both living and preserved tissue. Those combinations of certain atoms that result in a colored compound are called *chromophores*. When chromophores are attached to the benzene type of compound the result is known as a *chromogen*. Though a chromogen is colored it will not act as a dye for either tissues or commercial materials.

A chromogen, however, becomes a dye when to its combination of atoms another group, an *auxochrome*, is added. This last addition enables the compound to behave as an electrolyte. As an electrolyte it is able to dissociate and acquires a salt-forming capacity that makes it a dye in the true sense.

We can imagine a somewhat analogous situation in the creation of an automobile. The engine is a power plant that can do nothing but turn itself over until connected through the clutch to the driving wheels. Only then does the engine become functional and its power, acting through the transmission, converts a motionless structure into an automobile.

Are Stains Acid or Alkaline?

We commonly refer to biological stains as being acid or basic. The assumption follows that solutions of such stains should have either a low or a high *p*H,—be acid or alkaline. This is not true and the term "acid" or "basic" refers to the anionic (negative) or cationic (positive) electrical properties of a part of the dye molecule. While this in no way affects the acidity or alkalinity (*p*H) of a solution of a dye, it does determine the part of the biological cell a given dye will stain. An anionic or acid dye will stain the body or cytoplasm of the cell while the cationic or so-called basic dyes attach themselves to the contents of the nucleus.

Dyes can, by those who know the value of each part of their molecules, have their color materially changed and be made more or less soluble by additions or re-arrangements of the basic molecular set-up, even as a writer, knowing the value of words, can combine them so as to obtain the shade or meaning he wants to express.

Why Is Color?

We know that white light is a mixture of all the colors of the rainbow. The individual colors that are seen in Nature or in our own color creations we assume to be caused by the colored objects' absorption of all of the colors of white light except the one that we observe. Presumably the color we see is reflected back from similar material or color in the object. The cause of the recognition of color by the eye is something else again and it will probably be some time before we have an adequate understanding of the chemistry of optical reception.

The tremendous variety of artificially produced colors are known to depend on a relatively small but specific number of atomic groups arranged in particular ways. With this knowledge it is now more possible than was true even a few years ago to change the characteristics of old and to create new dyes practically to order.

Why Do Stains Stain?

There are theories galore to account for this phenomenon but they all fall into two general classes—physical and chemical—with something to be said for each and with no final decision being reached.

Those backing a physical explanation of how dyes work hold that the process is due essentially to absorption, that the tissues soak up the stain as a sponge does water. Chemical theories hold that some part of the stain molecule acually unites with a part of the cell that has points of attachment onto which the stain can latch.

Demonstrating the Chemistry of Tissues

The tendency of certain stains always to attach themselves to particular parts of the cell and, under varying conditions, to show differences in physical appearance, suggests a useful role for them as indicators of physiological changes in the biological research of the future.

Certification of Biological Stains

Biological stains are chemically tricky things to make, and in order to insure constancy in quality and results, the Biological Stain Commission was established under the auspices of the National Research Council in 1922. Each batch of dye intended for biological use is submitted by the manufacturer to the Stain Commission's technicians who test it for all the qualities, chemical and biological, the standard dye is known to possess. If the new batch meets the specifications, the maker is permitted to market it with the label of Certification by the Stain Commission that guarantees the behavior of the contents. International consistency of stain chemical composition is aided through the publication of two books (one in Germany and the other in England) that list all known dyes with their methods of manufacture and physical attributes. Each dye is assigned a number known (in the English edition) as the Colour Index Number, and all known chemical and physical facts about any dye can be found under its C. I. number.

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Activity of Raney Nickel Catalysts

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This article is abstracted from the Senior Thesis of E. C. Lim for the Bachelor of Science Degree in Chemistry at St. Procopius College, Lisle, Illinois.

Various Raney nickel catalysts were prepared by literature methods and their activity was determined over a period of six months. It was shown that the mode of preparation, and particularly temperature, affects the activity of the catalyst.

Raney nickel has been used successfully over the past three decades as an industrial and laboratory hydrogenation catalyst and more recently in reductive desulfurization work. Since various preparative methods appear in the literature for the production of the catalyst from nickel-aluminum alloy, it seemed desirable to ascertain, if possible, their relative effectiveness by some analytical procedure and particularly to note any deterioration in these catalysts after standing for an appreciable length of time.

Recently it was found[1] that an excess of Raney nickel when refluxed with an aldose or ketose in 70% ethanol gave good yields of the corresponding polyhydric alcohols. Since the extent of reduction to the polyols can be measured by a reducing sugar technique, such as that developed by Hagedorn and Jensen[2], it may be assumed that this would also be proportional to the activity of the catalyst. In other words, increase in the amount of reducing sugar remaining after refluxing with Raney nickel would indicate a proportional decrease in the activity of the catalyst. Such information regarding the initial activity or deterioration of a catalyst should be useful in its selection for a particular use, whether in the laboratory or industrially.

Raney nickel catalyst was prepared by four different methods and activity measurements by the sugar reducing technique were carried out on each sample over a period of six months. The results of these experiments are described herein.

Experimental Details

Preparation of the Raney Nickel Catalysts.— The common Raney nickel catalyst preparations have been designated as W_1, W_2, W_3 and W_4 respectively. Each of these was prepared according to the literature methods briefly described as follows:

W_1 [3]

One hundred g. of nickel-aluminum alloy (Gilman Paint and Varnish Company, Chattanooga, Tenn.) was added slowly to a solution of 100 g. of sodium hydroxide in 400 ml. of distilled water. The mixture was then heated at 115-120° for 4 hours after which 130 ml. of 20% sodium hydroxide solution was added. After three more hours at the same temperature, the volume was adjusted to 1 liter, and the aqueous phase was separated by decantation. The nickel was washed with distilled water until the washings were completely neutral and finally washed three times with 95% ethanol. The product was stored in a glass-stoppered bottle under ethanol.

W_2 [4]

A solution of 380 g. of sodium hydroxide in 1500 ml. of distilled water was cooled to 10°, using mechanical stirring, and 300 g. of the nickel aluminum alloy was added in small portions at such a rate as to maintain the temperature below 25°. After the addition, the mixture was allowed to come to room temperature and heated on a steam bath from 8 to 12 hours until the evolution of hydrogen virtually ceased. The sodium aluminate solution was decanted from the nickel and the latter was washed with 500 ml. of a 10% sodium hydroxide solution. The Raney nickel was then washed alkali-free as above and stored under ethanol.

W_3 [5]

In a two liter Erlenmeyer flask equipped with a thermometer and stainless steel stirrer was placed 128 g. of sodium hydroxide in 500 ml. of distilled water. The flask was cooled in running water and 100 g. of the alloy was added in 2 to 4 g. portions maintaining the temperature at $50 \pm 2°$ When all the alloy was added the cooling bath was removed and the suspension was digested at 50° for 50 minutes and washed alkali-free with distilled water and stored under ethanol.

W_4 [5]

This catalyst was prepared in exactly the same way as the W_3 except that during addition of the alloy to the sodium hydroxide the temperature was kept at −20° by means of a dry ice and acetone bath.

Analytical Procedure

Immediately after their preparation and at monthly intervals a 10 g. sample of the Raney nickel was refluxed in 100 ml. of 70% ethanol containing 1.5 g. of D-glucose. A one-ml. aliquot was removed at hourly intervals, diluted to 50 ml., and the amount of reducing sugar present was determined by the micromethod of Hagedorn and Jensen[2]. It was noted that after several hours the amount of reducing sugar became constant. This latter value was taken to indicate

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Aiding the Hearing Handicapped

• By Sam Posen
PRESIDENT, BELTONE HEARING AID COMPANY, CHICAGO, ILLINOIS

"The physical, medical and social sciences have taken gigantic strides in permitting the deaf and hard of hearing to lead normal, fruitful lives. But, unfortunately, many hard of hearing persons assume less than wise attitudes toward their handicaps."

This is a story of progress in aiding the deaf to hear from the time when Aristotle considered deaf persons sub-intelligent to modern times when hearing aids attract no more attention than eyeglasses.

Mr. Posen has recently formed the Beltone Institute for Hearing Research to sponsor and finance original study in hearing problems in conjunction with universities and hearing centers.

●

Research into the physical sciences often has needed no justification other than the fact that it pursues new information. A fundamental researcher can carry on his quest without much care as to whether the knowledge he gains will be of immediate benefit to mankind or will be a contribution to further investigation and study. For some scientists the fact that they have learned something that formerly was a secret of nature is in itself enough reason for having carried on diligent, and frequently self-sacrificing, study.

The world is blessed (as it has been thousands of times) when the fundamental researcher, or another scholar, can mold the new-found information so that mankind benefits. To the layman, at least, this is the justification for scientific endeavor — the principles of heat exchange mean nothing to the layman; the fact that he has the convenience of a refrigerator in his kitchen, however, does mean protection against food deterioration.

Millions of hard of hearing persons have re-entered the world of sound because researchers into the physical and medical sciences have sought information through the ages. But it is only in the past half-century that science has made significant progress in the development of a device to aid the hearing-handicapped, and, at the same time, society has begun to accept these persons without stigma.

It is important to note that many leaders in our culture, in government, in the entertainment world, in business, in every walk of life, wear hearing aids. It is not always that the hearing-handicapped have been able to rise to prominent public positions.

For instance, civilization probably has never produced a greater scientist and philosopher than Aristotle. His contributions stand out among the noblest achievements of man. Yet, it is ironic that he relegated the hearing-handicapped to a sub-intelligent caste. Speech is the primary vehicle for conveying thought, he reasoned, and therefore, since congenitally deaf persons could neither speak nor comprehend speech, they were incapable of learning.

A thousand years later, the Justinian code (sixth century A. D.) showed no more enlightenment than Aristotle. Although the code is the basis of modern

FROM TRUMPETS TO TRANSISTORS FOR BETTER HEARING

CHANGING STYLES in hearing aids from the mid-19th Century to today. In the foreground are early hearing devices, ranging from the Mid-Victorian Speaking Tube to the Double Microphone aid which came out just prior to the first World War. The young lady listens through the 1920 model Portophone with her right ear while examining a Beltone all-transistor hearing aid.

jurisprudence, under it the deaf and dumb were excluded from rights of entering contracts, from obligations of citizenship, and from witnessing in a court of law.

However, under the Mosaic law, a more kindly view was taken. The faithful were directed not to curse the deaf, since, presumably, their deafness was willed by the Lord. But, in later centuries, the Talmudic rabbis classified the deaf with fools and children.

For nearly 2,000 years of recorded history, the hearing-handicapped suffered at the hands of an ignorant society. In the middle of the 16th century, Girolam Cardano of Padua, an Italian physician, began to lift the fog. He contended that the deaf could be taught to comprehend written symbols by associating them with the objects they represented.

But the two men who stand at the forefront in the centuries-long march to enlightenment in attitudes toward the hearing-handicapped performed their great deeds some 200 years after Cardano. Abbé Charles Michel de l'Epee, a Frenchman, founded the first public school for the deaf in 1755. Shortly afterward, Samuel Heinicke, a German, founded the first public school for the deaf in Germany. Heinicke's, incidentally, also was the first recognized by a government.

That the two men disagreed about methods of instruction is less important than the fact that finally concrete steps had been taken to utilize to the fullest possible extent the talents, intelligence, and capabilities of the hearing-handicapped. The community's moral and legal obligation to provide instruction for the deaf and hard of hearing was emphasized. And the fact was established that the deaf are capable of learning.

The great European advances in educating the hearing-handicapped took hold in the United States in 1817, when the forerunner of state supported schools for the deaf in this country was established in Hartford, Conn. The Hartford school, now called The American School for the Deaf, was given its chief impetus by a young divinity student, Thomas Hopkins Gallaudet, who was sent abroad by a group of citizens to observe European methods in the education of the deaf.

Originally, the school had to depend upon private funds for support, but in a short time, public assistance was made available. Later, outstanding private and denominational schools established elsewhere throughout the country became notable for their oral methods of instruction.

Today, much of the stigma associated with hearing handicaps is imagined by the handicapped themselves. The physical, medical, and social sciences have taken gigantic strides in permitting the deaf and hard of hearing to lead normal, fruitful lives. But, unfortunately, many hard of hearing persons assume less than wise attitudes toward their handicaps.

In almost all cases, these attitudes are based on vanity. "I hear perfectly well . . . too many people mumble, that's all," is what must often be thought by the newly hard of hearing. "I'm too young to have something wrong with my hearing," or "I've been missing a few things lately, but I'm sure I'll be all right," they may say.

But, even if a hearing loss is recognized, there are still thoughts like this: "If I wear a hearing aid, I'll look old. I will look deformed. People will feel they have to make special allowances for me."

Yet, hearing aids are no more a sign of age or deformity than are eyeglasses. Especially today's hearing aids, which are as small as match boxes and which reproduce sound with wonderful clarity.

The attributes of convenient size and good reproduction have been available in hearing aids only in recent years. Some form of hearing aid has been present all through history, but pre-vacuum tube instruments were indeed sorry substitutes for natural hearing.

Probably the first appliance for aiding hearing loss came when primitive man cupped his hand to his ear to help amplify sound. It later was discovered that a sea shell would funnel sound to the ear. Then a hollowed-out cow's horn was tried.

Centuries later, the deafened Ludwig von Beethoven, used his own version of a hearing aid. He would hold one end of a wooden stick against his teeth and the other end against the keyboard of his piano. Sound vibrations caused by his striking a note would be transmitted through the stick to his teeth, from there to the bones of his skull and on to his middle ear. This same idea of bone conduction is used in some hearing aids today.

Beethoven's genius, and his method of hearing, of course, were unusual. The more conventional hearing aids during his day were hearing trumpets or horns, which had been in use since early antiquity. The trumpets or horns worked much like the cupped hand, collecting sound waves from an area larger than the ear opening and funneling the sound to the ear canal. Hundreds of different types were devised, many with elaborate carvings.

Some of these hearing trumpets were shaped to look like fans. Others resembled opera glasses. In one case, a hearing aid was incorporated into an umbrella. At the end of the 19th century, fashion dictated an ear trumpet that looked like an ordinary hat. In this contraption, sound entered through the top, then was funneled to the ear through a cleverly concealed trumpet.

The hard of hearing at the turn of the century, then, seemed to be awaiting help from science and technology. The horn and the trumpet, after all, were ineffectual devices. When was science going to provide something that actually *helped?*

The invention of the telephone pointed toward the first practical solution. In his search for a better means of teaching the deaf to speak, Alexander Graham Bell invented the telephone which, in turn, made possible the development of an electrical instrument to help the hard of hearing.

Dr. Ferdinand Alt of Vienna is credited with making the first effective electrical hearing aid. In 1900, Dr. Alt made an instrument that consisted of a small

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New Horizons for Polystyrene Foams

• By J. H. Taylor
CHEMICAL ENGINEER, CHEMICAL DIVISION, KOPPERS COMPANY, INC., PITTSBURGH, PENNSYLVANIA

Foaming plastics are of comparatively recent development. Do you know what they are, how they are made, their special advantages, and how they are used?

This is a story of an attractive and versatile material that is useful for many diverse applications, such as insulation, buoyancy, electronics, packaging, displays, and the like.

Many new uses will be found for the wholly new expandable Polystyrene.

In the years since World War II, expanded plastics have assumed an increasingly important role in industry. Activity in this field was at a low level prior to this time, with urea and phenolic foams being predominant. Two important developments occurred shortly after World War II—first, vinyl chloride polymers were foamed to be either as flexible as rubber or as rigid as hard rubber; and second, selected polyester resins were reacted with certain diisocyanates producing foams of controlled rigidity, strength and density for "in place" applications. The development of foams, which were improved in properties and processes, was not long in forthcoming; and in rapid succession, other developments in expanded plastics were unveiled.

Expandable Polystyrene, the newest addition to this field, was introduced in March of last year by the Chemical Division of Koppers Company, Inc. Marketed as tiny, hard particles of polystyrene with a blowing agent dispersed throughout each particle, this new polystyrene needs only the application of heat to cause a 20- to 30-fold expansion in volume. By confining these particles in a mold during heating, intricate, expanded objects of controlled densities can be produced simply by controlling the quantity of material charged to the mold. Besides the ability to be expanded to shape, this polystyrene foam has other equally important attributes, among which are toughness, high strength to weight ratio, low water absorption, low water vapor permeability, low thermal conductivity, low dielectric constant and low loss factor.

Properties

The Expandable Polystyrene is shipped in dense bead form (bulk density 37 lbs./cu. ft.) and may be expanded to low density foam at or near the point of use. The density and strength may be controlled by varying the quantity of bead material charged to a mold.

Molded foam has a high density skin which enhances its mechanical strength as well as its toughness and resistance to fracture on impact. This new polystyrene foam will support many hundred times its own weight at room temperature without crushing, yet it can be easily sawed, shaped and fabricated with common wood working tools. It can also be cut with a hot wire at low densities (2-4 lbs./cu. ft.). The tensile, compressive, flexural and impact strengths of molded, uncut specimens over a density range of 2-10 lbs./cu. ft. are given in Table I.

TABLE I
Strength Properties of Polystyrene Foam

Density lbs./cu. ft.	2	3	4	6	8	10
Tensile strength, psi	40	65	75	100	115	125
Compressive strength, psi 5% off-set	17.5	30	45	65	75	95
Flexural strength, psi	50	75	105	145	215	295
Impact strength, in. lb./in. unnotched	2.2	2.5	2.7	3.2	4.5	5.2

Because of the foam's non-connecting cell structure and small size, it is an excellent low-temperature insulating material. Thermal conductivity is a measure of the heat flow through an insulating material. Table II shows these values over a wide range of operating temperatures.

TABLE II
Thermal Conductivity of Polystyrene Foam

Average Mean Temp °F	19.9	75	120
Thermal Conductivity (B.T.U./hr./sq. ft./°F/in.)	0.214	0.243	0.267
Density—2.5 lbs./cu. ft.			

The water absorption of expanded polystyrene is extremely low due to its non-interconnecting cell structure and is less than 0.5% by volume after immersion for eight days at room temperature. This water is absorbed only at the surface of the piece and is readily lost to the atmosphere once the foam is removed from the water.

Resistance to the passage of water vapor is an important property of low-temperature insulation materials. Expanded polystyrene is an excellent water vapor barrier between areas having different humidity conditions. The water vapor transmission rate through expanded polystyrene is very low—0.5-1.0 grains/hr./sq. ft./in. of Hg vapor pressure difference.

Expanded polystyrene may consist of up to 97% air. Because of this, its behavior as a dielectric is nearly as good as air itself in some instances and better in others. The values for dielectric constant, dissipation factor and loss factor are given in Table III.

TABLE III

Electrical Properties of Polystyrene Foam

Test Conditions	Properties From 10^2 to 10^8 CPS		
	Dielectric Constant	Dissipation Factor	Loss Factor
As received	1.02 - 1.07	Less than 0.0005	Less than 0.0006
48 hrs. @ 50°C	1.05 - 1.06	Less than 0.0005	Less than 0.0006
96 hrs. @ 35°C & 90% R. H.	1.05	Less than 0.0005	Less than 0.0006

The low water vapor permeability and low water absorption of polystyrene foam are readily discernible from these data when it is noted that there is only a very slight change in electrical properties with changes in humidity.

Expanded polystyrene is basically polystyrene, which is a thermoplastic material. Therefore, its use is restricted to applications in which the operating temperature range does not exceed approximately 175° F. under conditions of no load.

Uses

A. Insulation

A good low temperature insulating material should possess most, if not all, of the following properties:

1. Structural strength
2. Resistance to the flow of heat
3. Low water vapor permeability
4. Low water absorption
5. Lightness of weight
6. Resistance to rot and vermin

All of these properties have been tailored into expanded polystyrene. Structural strength allows utilization of the foam in sandwich construction where strength and insulation efficiency are advantageously combined in one material. Good resistance to water vapor transmission and water absorption minimizes reduction in insulation efficiency caused by condensation in the insulation.

Moldability, along with this combination of properties, makes expanded polystyrene adaptable to many cold temperature applications. These insulation applications cover such items as refrigerator cars and trucks, low temperature industrial piping, refrigerator evaporator chests, general refrigerator insulation, air conditioning units, or general insulation where temperatures do not go above 175°F. With the introduction of an expandable polystyrene which can be simultaneously expanded and molded to shape, it is possible to mold an insulation to fit intricately shaped cavities without resorting to expensive fabrication.

B. Buoyancy

The strength, low density and low water absorption of this polystyrene foam make this material highly desirable for use in buoyant members of boats, rafts and other marine equipment. Void spaces may be completely filled by foaming expandable polystyrene to the desired contour in molds or in place. If a compartment filled with this foam is punctured, buoyancy is not lost since this foam will not absorb water.

C. Sandwich Construction

This polystyrene foam may find outlets in engineering construction in shapes made by laminating thin, high strength materials to the foam core. In this operation, the face material may be adhered to the foam core by use of a proper adhesive. Thus, mechanical strength of panels would be greatly increased without an appreciable increase in weight. Expanded polystyrene has the ability to be adhered to face materials, such as wood, laminated plastics, paper and others. The foam will remain dimensionally stable with changes in humidity because of its low water absorption. The low thermal conductivity of the foam also will impart insulating properties to panels containing it.

D. Packaging

Expandable Polystyrene's ability to be foamed to shape suggests still another useful application as a packaging material. Foam may be molded to the exact dimensions of a delicate instrument or heavy object that must be protected and cushioned against shock in transit. As a liner for insulated boxes and cartons for low temperature shipments, the foam is unaffected by water and will retain its shape and strength on repeated or prolonged contact with water.

E. Electronics

One of the most striking qualities of expanded polystyrene is its electrical properties. Polystyrene foam has a low dielectric constant and low loss factor at microwave and radar frequencies, making it useful as a dielectric in transmitting and receiving assemblies. Aircraft radomes could use foam as a core material because of its ability to be foamed to exact shape. Moreover, in many electronic applications, changes in humidity conditions often have adverse effects on dielectric materials; but the electrical properties of the polystyrene foam exposed to high or low humidity conditions remain unchanged. This new development gives electronic engineers a new material which may be foamed to shape, with superior electrical characteristics.

F. Toys, Novelties and Displays

In this field, manufacturers require something new and attractive to catch the eye of the buying public. Now, polystyrene foam articles can be foamed to shape instead of pressing or cutting them from flat sheets. This affords greater freedom of design and simplifies the manufacture of complex shapes.

Molding of Expandable Polystyrene

There are a few basic requirements that are essential in the molding and foaming of Expandable Polystyrene. First and foremost, there must be a source of heat, for heat energy must be transmitted to the solid beads to accomplish foaming. Second, in order to obtain the shape desired, there must be a mold for the piece. The molds themselves need not be massive or expensive, for this operation is essentially a low pressure one. Third, provision must be made to cool the foam in the mold after expansion.

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New Books

The Microtomist's Formulary and Guide

• *By* PETER GRAY. New York: The Blakiston Company. 1954. Pp. XIII + 794. $10.50.

Dr. Gray's modest Preface gives no indication of the all-inclusive character of his book, surely the outstanding work of its kind. Such a stupendous amount of research and labor went into its preparation that it may well have been as he notes "a wearisome and disillusioning task." He has, however, produced a source reference work that is a "must" for every college, university, and hospital library, and for every laboratory worker in any field who prepares objects for microscopic examination.

Part I is devoted to the art of making microscope slides of all kinds, wholemounts, dry, aqueous, nonaqueous; gum, jelly and resinous media; smear preparations from fluid material, cut surfaces, and solid bodies; ground sections, paraffin sections, frozen sections, and many others.

Part II lists the formulas, and discusses the methods for making slides: preservatives, fixatives, stains, metal stains, solvents and oils, and mounting and embedding media. Some 3500 generally used formulas are cited and identified by a decimal system "to insure that no formula for a solution is given more than once and that each solution is placed with other solutions of similar composition and properties."

The mere listing of the books and periodicals cited occupies ten closely printed pages. The extent of the work is indicated by the fact that the Index alone occupies 113 pages.

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Religion and Society

• *By* ELIZABETH K. NOTTINGHAM. New York: Doubleday and Company, Inc. 1954. Pp. VII + 85. $0.95.

In this small work Professor Nottingham gallops with abandon in many directions. The Catholic sociologist will find it impossible to reconcile her wholesome acceptance of secularism while at the same time trying not to disregard the spiritual evaluation of religion. The book expressedly seeks to provide the reader with a concrete point of view concerning the part played by religion in human societies, but it nevertheless completely disregards all conceptions regarding the Divine origin of religion. All of which is like a fortuitous chasing of a scientific rainbow.

It is indeed true, as Professor Nottingham suggests, that a small book of this size inevitably raises more questions than it answers. Perhaps, the basic weakness of the book is that there is no willing acceptance of a natural and Divine law which pervades all peoples and all societies. The many loose ends or non-conforming facets might with relative ease be resolved had there been an acceptance of absolute ideals.

The Catholic sociology student will find apt answers for the book's many confusing moral problems as they relate to customs, traditions, mores or folkways, by applying his conception of an unrelenting and constant morality. Indeed, throughout the book much of the conflict concerning sociological conceptions of morality could easily be eliminated through a more definite qualification of terms. For example, the term "morality" could have been used in a broad and general sense to describe the duties of man toward his fellow man in any given culture as those duties are practiced and sanctioned by that particular cultural tradition; "Christian Morality" would then qualify the frame of reference and designate those duties of man to man on a constant and unchanging basis.

Sects and cults, according to Professor Nottingham, did much to confuse and dissemble many social groups. This phase of social pathology, from the viewpoint of religion, is easily understood since the subjective interpretation of morality and religion always has led and always will lead to frustration and confusion.

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Treasury of Philosophy

• *Edited by* DAGOBERT D. RUNES. New York: Philosophical Library. 1954. Pp. XXIV + 1280. $15.00.

After the splendid volume edited by D. D. Runes under the title *Twentieth Century Philosophers*, this volume is somewhat of a disappointment. The *Treasury* consists of about 400 selections, covering all ages and countries, with special attention to Oriental and American philosophers. The brevity of the selected passages—on the average about two pages—caused one philosopher to remark that the *Treasury* contains only small change.

The choice of texts is not always fortunate. For example, the whole of the immense philosophy of Thomas Aquinas is represented by a short passage about a very minor problem (whether intelligible species are de-

rived from separate substances); on the other hand, almost a dozen selections are given of Pre-Socratic philosophy, whose remaining fragments do not fill more than one small book.

Nevertheless, the *Treasury* can render useful service to the professional philosopher who wants quick biographical references and to the general reader who is satisfied with having at his disposal a few words of many of the world's great thinkers.

Henry J. Koren, C.S.Sp.
Department of Philosophy
Duquesne University

Careers and Opportunities in Science

• *By* PHILIP POLLACK, New York: E. P. Dutton & Co., Inc. 1954. Pp. 252. $3.75.

One of the best "Science Counselors" we have seen. A book for every secondary school library and for the book shelf of every person engaged in student guidance. Probably the most attractive of the "career" books, it will grip the interest of every girl or boy who is trying to decide on a life work. It will soon be well-thumbed.

With few exceptions it lives up to its ambitious title-page claim, "A Survey of All Fields." In an easy personal style the author points out the opportunities that are open to trained, disciplined and qualified workers in a number of occupations based on science, such as chemistry, plastics, electron physics, meteorology, atomic energy, agriculture, conservation and medical research. Emphasis is placed on the opportunities offered in the various fields rather than on the manner of preparing for them, but a considerable number of schools are listed, as well as the salaries workers may expect. Young people will not overlook the statement that genius is not necessary for a career in research science but a high degree of intelligence is.

There is an introduction by Dr. Harlow Shapley and a chapter devoted to future career possibilities in fields involving atomic energy, the conquest of interplanetary space, health, medicine and aviation.

H. C. M.

★ ★ ★ ★ ★ ★

How to Attain Great Age

(Continued from Page 10)

energy; she is economical in her activities and works without much apparent exertion. She allows herself ample time in her creative acts and yet she continuously produces new life by proceeding from the germs at hand and—in a kind of chain reaction—transmits these germs, strictly differentiated by species, from one living creature to another of the same kind.

Whether he likes it or not, man, a relatively small member of this system, is linked with the vegetable and animal kingdoms in this chain of living creatures, a chain that is constantly renewing and changing itself, following the fundamental unchangeable rhythms of this natural event. The plant and animal worlds conform to these rhythms and cycles in the course of their development and life, but is such obedience the rule among headstrong, creative men, who often are so proud of their "common sense"?

Nature has endowed man with a special warning system, namely the vegetative neural system, which, independent of the human expressions of will, is important as an automatic "biological regulator." It houses the "life nerve" that is made up of the pair: sympathetic and parasympathetic nerves. This system controls, among other things, the action of the heart and the glands, the size of the blood vessels, the rate of respiration, the constrictions of the stomach and intestines, the production of antigens and inhibitors. It serves as the link between body and soul; it functions without interference from the man himself.

Therefore, the preeminent duty of self-preservation is to protect this nervous system in its delicate working against external disturbances and excessive stimulation in particular, and to pay prompt attention to its alarms. The accumulation and persistence of exhaustion symptoms emitted by frayed and worn out nervous and energy centers imperatively demand relief and release; remedies that are best provided by radical changes in activities, and which will be served by centers that have hitherto been used to only a slight extent. The exaggerated faith in hormone preparations is unfortunate; these compounds cannot restore vanished youth. Their effects are transient and, if administered over a long period and in massive doses, there is distinct danger of carcinogenic results.

Modern life is indeed a heightened "struggle for existence" not only for the business leader and the prominent politician but also for the experimental scientist who wishes to make a mark in his field. In every station of life, there is a struggle for rank, recognition, material goods, ideas, fame, success. This struggle proceeds as a continuous reaction, with overstraining of nerves and energies, amid commotion and hurry, in an environment filled with foreign noises and bright lights. Almost 2000 years ago, Virgil complained about "the noisy strife of the infernal avarice," and Goethe, a notoriously early riser, feared "the trifles of the day." There was good reason for the philosophers to hope for a "Tusculum," i.e., a peaceful retreat, where amidst natural surroundings they could work and find recreation. Even the old classical literature contains the admonition: "Back to Nature."

To grow old is a part of life itself, but to become aged and senile prematurely denotes a failure in the conduct of a man's life. Can these eventualities be avoided and postponed by proper prophylactic measures?

The great Dutch physician and chemist Hermann Boerhaave, (d. 1738), taught *Simplicitas sigillum veri.* Youth is the precursor and the preparation for old age; strength for the whole life is stored up during this preliminary stage. The old adage states: "Once a use, ever a custom." Moderation need not be synonymous with Spartan simplicity. If a man is temperate and simple in his habits in his early years, if he is physically and mentally active, cheerful and yet determined in the face of impediments and significant obstacles, he will probably reap the largest harvest of his mental-creative originality about his 50th year. Around this age he ought to give careful attention to any warning signals put out by his nervous system and redirect his psychical-mental powers and efforts. Finally, it should be emphasized that bodily activity and mental exercise and intellectual mobility are valuable adjuncts in youth as well as in old age. ●

After a Hurricane

(Continued from Page 12)

A few people will be forehanded enough to provide themselves with water purification tablets. More power to them, and our blessings; but if you are not that forehanded, at least you should scotch-tape the information in this article to the inside of your medicine cabinet. If you ever need these facts, you will need them badly; then it may be hard to find them.

What Food Will Be Safe?

After an attack, the contents of cans, jars, cartons, and other food packages that have not been broken, will be safe to eat. Think of radiation as a dust or ash, not as a penetrating ray, and you will know better how to protect yourself from it. You will see that a tight package would protect food. These invisible radioactive dust particles can make you ill if enough get inside your body, so wipe or wash carefully any can, bottle, or other container, or the cooking utensils you use. Such dust can be removed by wiping or washing, but neither soap nor boiling water makes the particles harmless. They are still "hot," and will remain on the cleaning cloth or in the wash water, so empty or rinse outside the house the pails or tubs you use. Be careful not to allow such particles to reach your mouth. Don't burn contaminated cloths, as this releases radioactive smoke. Put them in a covered receptacle; the decay rate of radioactivity means that they will become less and less harmful as time goes on.

Food that has been stored in closed cupboards or in your refrigerator will be safe, but do not eat any food that may have been on an open shelf, or unprotected, as, for example, in a garden.

Don't hoard food, but do make sure that you have on hand a 3-day supply at all times. Most of us normally have a surplus anyway, what with food that is in the icebox, the canned fruit and vegetables in the cupboard, the cookies, dry cereals, soups, teabags, raisins, etc., that we find on most shelves. It is better to slightly increase the supply you normally keep on your shelves than it is to put aside a particular emergency ration, because some packaged foods spoil when stored for long periods.

Bear in mind that you may need to eat cold food for a while. Supplies of canned fruits and vegetables should be substituted for frozen and fresh, which spoil easily in the event of refrigeration failure.

It is good to avoid salty foods, since drinking water may be at a premium; raisins and chocolate are good energy builders and take up very little room. Canned fruits, fruit juices, vegetables, soups, fish, milk, meat, and baby food, as well as dried foods make a good emergency ration.

After attack, the civil defense authorities and the food industry will make every effort to get food stocks flowing again, but it is quite likely that tight food rationing will go into immediate and long-lasting effect. There is likely to be a complete "freeze" on all sales of food immediately following an attack. It is for this reason that all householders should be prepared to be self-sufficient, without going to a store, for at least three days.

Frozen Foods

The food in your refrigerator or home freezer will last for about 36 hours if it started out frozen solid. Perishable items should be eaten or cooked after twelve hours. If you cannot cook them, throw them out before they contaminate the rest of the food. Once foods have started to thaw, they spoil very quickly; never refreeze them until they have been cooked.

Milk spoils easily; if in doubt about the purity of yours, boil it. It won't taste very nice, but it will be safer.

Remember that biological and chemical warfare may be used to affect all food supplies. Instructions will be given locally by civil defense authorities if this is suspected. Follow official instructions carefully. These will reach you through your warden, by radio or by your newspaper. Rumors designed to make people throw away perfectly good food are often started by enemy propaganda. Be ready to do your part in stopping these. Don't listen to them; don't pass them on. Pay attention to *official* instructions only. To be safe, paste the true facts inside your cupboard door now, when you can do so calmly. Then, if trouble comes, you will be able to refer to them and will know what to believe. ●

(See FCDA Manual on Home Sanitation)

Science Careers for Women

(Continued from Page 2)

In the industrial world, on the other hand, there are still some residual prejudices and long-established taboos. Although in most research laboratories there is little hesitation about putting women into any position for which they are qualified, where the job in question involves travel to field operations, branch installations, or contracting agencies, a woman is seldom considered, for reasons that are obvious, whether logical or not. The field is still a man's world, into which only the most intrepid female ventures to intrude—although the invasion that has occurred in the earth sciences is noteworthy. Yet, even here, relatively few women field geologists are engaged in commercial work.

The impression prevails that women are not temperamentally fitted or adaptable to the larger problems that characterize field operations, whether it be in geology or engineering. Many of these problems call for a combination of skill, daring, and calculated risk that few women scientists are ever called upon to display. The exceptions are truly exceptional by any standard of measurement, and the unusual nature of their accomplishments is proof that they cannot serve as the basis of a generalization to contradict the prevailing view. In contrast, many women have displayed outstanding talent in certain laboratory techniques, and it is safe to say that in several fields they excel men.

Biology is one such field to which women are attracted, and they have made names for themselves in microbiology and micropaleontology. Interest in biology has drawn many of them into medical research, but they are also numerous in laboratories devoted to genetics and plant pathology. In 1953, 2745 (twenty-nine per cent) were graduated from our colleges with majors in biology; 346 (eighteen per cent) earned masters' degrees; and 117 (twelve per cent) won coveted Ph.D.'s. Indeed, this figure—117—represents sixty per cent of all the Ph.D.'s in science awarded to women.

Second in popularity is chemistry, where fifty-one doctorates were earned by women. Like biology, chemistry affords entree to many different kinds of activity. Half the women who earn degrees in chemistry (approximately 1250 in 1953) enter the industrial field, where they are especially expert in analytical chemistry. Here, as in educational and governmental work, they can develop specialties in medical or pharmaceutical chemistry, any one of the numerous industrial specialties, and agricultural chemistry, not to mention the fascinating fringe fields of geochemistry and physical chemistry. A few venturesome souls have entered the more rugged field of chemical engineering, which is, in fact, claiming more women each year.

With shortages of manpower in so many professions, women have an unparalleled opportunity to entrench themselves more firmly in those in which they now have only a precarious toehold. They need not worry about the occupational hazard of becoming a "long-hair." A recent study of Bryn Mawr Ph.D.'s in science revealed that every one of them had had interesting employment—half of them in teaching, half in industrial or governmental research or management. Times have changed: Only a quarter of the older graduates married, but at least half the younger ones enter matrimony, with or without the interruption of their careers. All who responded to the survey (only four out of seventy-nine failed to do so) have evidently "succeeded in life," and succeeded in living full and normal lives.

Every fact and statistic on women in science leads clearly to one conclusion: Those young women who feel the urge or hear the call to enter a scientific or engineering profession should at least try out for it, regardless of the "advice" of family, friends, or counselors. Mathematics and science courses in high schools provide a fair sample of things to come. If the urge or the call survives them, the real test comes in college. Science and engineering are not havens for mediocre people, for even the average person engaged in the more routine work of the professions has been found to possess a high intelligence quotient. For such people, male or female, there is a fascinating future, to which a lively imagination and thorough training make equal contributions. The rewards are large for the modest price the student pays to get the basic training. ●

★ ★ ★ ★ ★

"The spectacle of a nation praying is more awe-inspiring that the explosion of an atomic bomb."

J. Edgar Hoover

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Insecticide-Resistant Flies

(Continued from Page 6)

toxicity to warm blooded animals but satisfactory toxicity to flies and providing at least four weeks' residual effectiveness at practicable field dosages. A number of compounds have been investigated both in the laboratory and in the field with very encouraging results.

Among those investigated, two new insecticides, which are now or are soon to become commercially available and are registered for fly control in California, have been particularly outstanding. Three to five weeks or more of effective residual control have been routinely obtained with residual applications of Chlorthion and Diazinon at the rates of sixteen to thirty-two pounds of the twenty-five per cent wettable powder or two to four gallons of the twenty-five per cent emulsifiable concentrate per one hundred gallons of finished spray. A third material which can be effectively applied is malathion. Residual applications of forty pounds of the twenty-five per cent wettable powder or two gallons of the fifty per cent emulsifiable concentrate per one hundred gallons of finished spray will achieve effective residual fly control but of somewhat shorter duration than for Chlorthion or Diazinon. Under most circumstances, the length of effective residual control can be extended for a week or more with all three of these insecticides through the use of a bait-type residual spray by adding one half to one pound of sugar per gallon of finished spray.

A new technique in house-fly control, which is receiving increasing acceptance, is the use of dry sugar baits. Dry granulated sugar containing one per cent of actual Chlorthion, Diazinon, malathion or Dipterex (a new material which is very effective in baits but not as a residual spray) is very lightly sprinkled at the rate of one ounce per thousand square feet on floors, walks, window ledges and other areas where flies are likely to congregate. Similar treatments with water baits containing one-tenth per cent of one of the above insecticides and ten per cent sugar, unsulphurized molasses or corn syrup at the rate of one gallon per thousand square feet can also be used. The quantity of dry or liquid bait and the frequency of application will vary with the initial house-fly population and the related breeding potential. Daily applications are necessary at first until the adult population and breeding potential are reduced to sufficiently low levels, when usually the intervals between applications can be lengthened as necessary to maintain control.

The results, briefly summarized above, lead us to look with some degree of optimism at the future for fly control. This optimism stems from signs of a definite trend toward a decrease in resistance to the chlorinated hydrocarbon insecticides in the field, from the failure of other flies to develop resistance at the same locations where house flies became resistant, from the continuing failure to select house-fly resistance to the organic phosphate insecticides and pyrethrum and, finally, from encouraging laboratory and field results with new organic phosphate insecticides and techniques for fly control. They give hope that further fundamental investigations will allow us to overcome the problem of insecticide-resistance wherever and whenever we may meet it. ●

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Chemist's "Magna Charta"

(Continued from Page 11)

Duratile of Ohio in Fremont supplied the colored metal wall tile and other materials of construction. To the Art Department of the College goes the credit of hand-lettering the symbols of the elements and other data on the ten by ten inch tiles. The work was designed in the Chemistry Department and its construction was there supervised.

Duratile is a zinc bonderized, sheet metal that has been spray painted and baked to produce tiling material in a variety of exquisite tints and colors. It is attached to sealed wall surfaces by means of mastic. Thus it has a certain degree of flexibility under temperature changes and it is not subject to the danger of cracking and crazing commonly encountered with ceramics. It is easily washed and polished. Though it is damaged only with difficulty, individual tiles are readily replaced. This is an attractive feature in that it reduces worry about changing atomic data, new elements and renamed ones. Further, old tiles can be overlaid with new ones, where necessary. With such material, the ancient art of tesselation becomes modern and functional.

The borders of this chart are done in black tile, two and a half inches wide; the black divisions between the elements are mostly of five-eighth inch width. While most of the solid elements appear in black enameled lettering on white tile, those of the liquids are done on powder blue, and the gases are allotted yellow tile. Symbols for the lanthanide and actinide series, however, are done in deeper maroon on peach colored tile. Roman lettering was used throughout. Unlettered tiles are generally in white, with color patches to break the monotony of the white, as suggested by tinted insertions in leaded glass windows. All atomic numbers are lettered in red; atomic weights, generally to four significant figures, appear in blue. Current technical notation of a subscript to the left of the symbol, for atomic numbers, and of a superscript to the right for atomic weights, was followed throughout.

The so-called long form of the periodic table was selected as likely to be in vogue for the longest time. The tempting luxury of overloading the symbols with secondary data was everywhere eschewed. Fanciful tiling designs were even rejected in order to emphasize its stern functional demands. ●

Aiding Hearing Handicapped

(Continued from Page 20)

microphone which looked and worked much like the telephone. It included a receiver and dry cell battery with connecting wire. Certainly there was plenty of room for development, but this carbon-type hearing aid was an important improvement over the ear trumpet. The increase in amplification it produced was not appreciable; the sound would fade out or come back, depending upon the position of the wearer's body and the shifting of the carbon granules in the microphone. In addition, the power was inconsistent—one moment a conversation would come through as a whisper, then as a roar.

The next important step for the hard of hearing, the development of the vacuum tube in the 1920's, led to the birth of the hearing aid industry. The vacuum tube made it possible to effectively amplify and keep sound at a consistent level. The first wearable vacuum tube hearing aid, produced in 1937, was bulky—but nearly-normal hearing was made possible.

These early electronic instruments, small by standards of preceding years, are giants by today's standards. The early vacuum tube hearing aid consisted of a crystal microphone, a vacuum tube amplifier, "A" and "B" batteries, and a crystal receiver. Women often wore parts of the instrument strapped to their thighs; men concealed theirs in their hip pockets. But science was at last on the right track.

The accomplishments of the years 1940 to 1947 are gratifying: vacuum tubes were reduced three-quarters in size, half in cost, two-thirds in power consumption. Their amplification was doubled, and filament life was increased 10 times. The year 1943 saw a major change in the electronic instrument, with all the elements of the hearing aid combined into a single pack. Separate battery attachments and long connecting wires were eliminated. The hard of hearing now had a compact, highly-efficient scientific instrument.

Other improvements followed. Further miniaturization of bulky components was made possible by the development of printed circuits. Then, in January, 1953, the transistor was introduced.

The transistor takes the place of vacuum tubes and a "B" battery, enabling a hearing aid to be operated on only an "A" battery. Unlike glass vacuum tubes, transistors are virtually immune to damage from shock or vibration.

There are other wonders of the transistor that make it so important to the hearing-handicapped. Germanium transistors have a minimum life of about 90,000 hours, or about 20 years' hearing aid use, as compared to little more than a year for vacuum tubes. A vacuum tube instrument costs as much as $50 a year to operate; with transistors, the expense is only about $5 a year.

While the size and weight of hearing aids have been reduced a third in the past ten years, their general efficiency has been upped more than 300 per cent. Despite the vast technical improvements and the precision and painstaking care that goes into making a modern hearing aid, prices have increased less than 20 per cent since 1943. And operating costs have been forced down continually.

What effects future research will have on the hearing-handicapped is a matter of conjecture. But I say this with confidence: concrete progress for the hard of hearing has occurred within only the relatively recent past. The future will hold for them at least equally important gains. ●

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Du Pont Fellowships for Teachers of Chemistry

Dr. Theodore A. Ashford, Director of the Institute, announces that Saint Louis University has been awarded an $8,100 grant from E. I. du Pont de Nemours and Company for the general support of its Institute for the Teaching of Chemistry.

A grant of $4,500 will provide twelve fellowships for High School and Junior College chemistry teachers, enabling them to attend the University's Institute for the Teaching of Chemistry in the summer of 1955. The fellowships provide tuition of $100 and a living allowance of $180 for the student.

A grant of $3,600 will provide two fellowships for the support of qualified recent college graduates, who wish to work toward a Master of Science in the Teaching of Chemistry, during the academic year 1955-56. The year's study will prepare recipients of the fellowships to teach chemistry, physics, or mathematics in a secondary school. Each fellowship will provide $450 tuition and a stipend of $1,200 for the student.

The Institute for the Teaching of Chemistry was founded in 1950 to meet the rising need for correlation between the fields of education and science. Up until the formation of the Institute, there was no program designed to fill the needs of the secondary school teachers, since the traditional research Master's degree in chemistry is directed toward the preparation of the professional chemist rather than the teacher. The Institute is administered by the Chemistry Department with the cooperation of the related science departments and the Department of Education.

The Institute's program consists of three phases. It offers a B.S. degree in the Teaching of Chemistry; an M.S. degree in the Teaching of Chemistry, and a six-week Summer Program for M.S. degree candidates and for in-service training of teachers.

Qualified applicants may write directly to: Dr. Ashford, (Director of the Institute For The Teaching of Chemistry), Saint Louis University, for further information concerning the fellowships and a bulletin describing the Institute.

Biological Stains

(Continued from Page 17)

The histologist of the past learned more of the minute make-up of living things through the use of stains that accentuated details of cell structure. The microscopist of the future will use many of the old and perhaps many new stains to learn how the tiny structures of the cell operate. The results should lead to longer and more comfortable living. At the University of Erlangen in Germany there is a marble bust of Gerlach who did much to start the past century's use of tissue staining. On this bust is an inscription that was true when carved, is still true a century after his published research appeared and, in the broadest sense, is likely to be so indefinitely—

HISTOLOGY DEPENDS ON STAINING. ●

Acknowledgments

In preparing this account the writer has leaned heavily on the material so simply, thoroughly and briefly presented by Dr. H. J. Conn in his book *Biological Stains.* The reader desiring to fully acquaint himself with stain behavior should, by all means, refer to Dr. Conn's book.

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★ ★ ★ ★ ★

Liberal arts are the skills of the mind which are the particular responsibility of the college. Fundamentally they have to do with two vast and important areas of skills—language on the one hand and mathematics on the other. They make us expert in the species or kinds of things on the one hand, and in their quantities on the other. They answer the questions: What kind? and How much? They help us to be precise and exact in our thinking, in our speech, and in our understanding. We acquire them only with effort, for they involve memorizing, calculating, measuring and manipulating. We learn them best by discipline and a carefully conceived plan. We neglect them at great cost, for we can hardly claim to be educated persons without them. College courses which do not consciously aim at their acquisition somehow cheat the student of what is his right.

Richard D. Weigle
President, St. John's College (Maryland)

Raney Nickel Catalysts

(Continued from Page 18)

the overall reduction which had taken place, and the per cent sugar reduced in each case was plotted against time of aging of the Raney nickel preparations illustrated in Fig. 1.

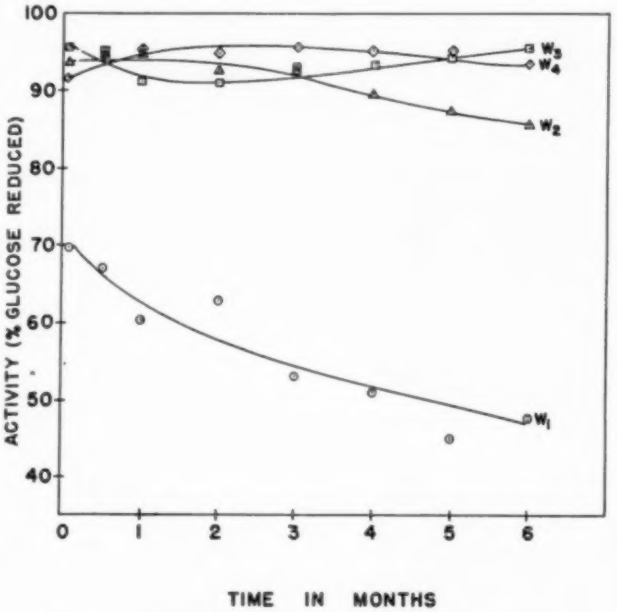

FIGURE 1. Relation of reduction of glucose to age of catalyst.

Discussion of Results

Assuming that the activity of the catalyst is directly proportional to the amount of sugar reduced, it then becomes evident from Fig. 1 that of the four different methods of preparation at least one Raney nickel catalyst was obtained with somewhat noticeably lower activity. Furthermore, this particular catalyst, W_1, continues to lose its potency upon standing and should not be stored indefinitely. Perhaps this lower activity can be attributed to the higher and more prolonged temperature employed during its preparation. The other three preparations, W_2, W_3 and W_4 made at lower temperatures possess a definitely higher initial reducing activity and of these only the W_2 catalyst shows a slight decrease in reducing power within 6 months.

This information should be particularly valuable in choosing a Raney nickel for reductive desulfurization studies and perhaps even in high pressure industrial hydrogenation. In certain cases, however, such as in the reductive desulfurization of thiol esters to aldehydes[6], a less-active, aged Raney nickel may be desirable; aged W_1 catalyst was actually used in this work. ●

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Timing a Solar Eclipse

(Continued from Page 5)

Camp life was not always free of troubles. At times the wind velocity reached fifty miles per hour and threatened to propel the tents into the sea. The weather was generally favorable. The mean daily variation of temperature was about 20°F. The thermometer reading never dipped below freezing, the lowest recorded temperature being 34°F., from June 16 to July 1. There was little rain, but heavy fogs occurred frequently. Unfortunately, the weather on eclipse day was most unfavorable. Totality occurred at 8:25 A. M. At 4:30 A. M. a light drizzle began, and continued through the eclipse. The temperature dropped from 62°F. at 3:00 A. M. to 41°F. during totality. Only a small drop in temperature generally is noticed during an eclipse.

The photoelectric observations were begun with a dense cloud cover that fortunately remained uniform throughout the duration of the observations. More than 50 per cent of the WWV time signals were received and recorded, which is a sufficient number for measuring the tape. The observers were obviously disappointed in not having seen a total solar eclipse, for all they noticed through the clouds was an awesome darkness, which seemed to make the landscape darker than it had been in the middle of the night.

None of the five sites in Labrador had clear skies for the eclipse, but all brought back usable photoelectric curves. The advantage of the photoelectric method was well realized in the June 30, 1954, eclipse, when most of the seventeen sites had clouds.

The success of the entire eclipse project depended upon the few short minutes before and after totality. Months of preparation and a great deal of expense were required to gather a small amount of data. To the layman, the extravagant nature of such an undertaking seems largely unjustified, especially when undertaken by a governmental agency. But the complexity of scientific projects is many times greater today than fifty years ago. Most scientific undertakings require years of study and preparation before any results can be obtained. The eclipse project furthermore involves a distinct element of risk. There can be no second chance. A breakdown, whether it be electronic, mechanical, or psychological means complete failure if it occurs at the time of eclipse. One cannot try again an hour or a day later.

Project Eclipse is merely one of many far reaching scientific projects undertaken by the research divisions of our military forces. It is quite apparent that the defense system of the United States is not becoming scientifically effete; for the military has realized that science can be its servant in maintaining the peace and, if necessary, in the waging of war. The Geophysics Research Directorate of the Air Force Cambridge Research Center is just one of the many research divisions of the government, all integrated and all utilizing the great potential of science in maintaining America's military supremacy. ●

Polystyrene Foams

(Continued from Page 22)

The most efficient and successful method of heating is the direct injection of dry steam into the mold cavity through small holes drilled in the cavity walls. The large quantity of latent heat available in steam results in rapid expansion cycles. Indirect heating of the polystyrene by heat transfer through the mold walls by conduction is possible in some cases when thin sections are expanded. However, the expansion of sections one inch or greater in thickness by conduction heating is very slow and may result in incomplete filling of the mold. Temperatures necessary for proper expansion range between 250-275°F. Steam pressures between 20-30 psi satisfy this requirement. The foam itself must be uniformly heated to these temperatures in order to yield satisfactory expansion and fusion. Uniform steam distribution or heating is essential to prevent undesirable density gradients. Rapid transfer of heat to the expandable material aids in preventing temperature and density gradients.

Cooling of the foam is an equally important part of the molding process. As the foam is thermoplastic, it must be cooled to 120-125°F. before opening the mold. If this is not done, it will continue to expand when the mold is opened. At low densities, cooling must be carefully controlled to prevent shrinkage.

Expandable Polystyrene Beads are normally charged to molds in the unexpanded state. However, for some applications, it may be desirable and perhaps necessary to use partially pre-expanded beads. Thick sections, pieces of irregular contour, thin vertical pieces or low density pieces are in general, most advantageously molded from pre-expanded beads. Pre-expansion is done at the point of use with dry heat (infra-red bulbs or strip heaters) to accomplish the desired degree of expansion outside of a mold. The partially expanded beads remain free-flowing and can be poured into molds.

Extrusion of Expandable Polystyrene into low-density foam will surely find increasing use for the production of such items as flat sheet, rod or perhaps pipe covering on a continuous basis. Industry is finding the versatile combination of properties offered by Expandable Polystyrene to be particularly attractive for many uses. It opens new horizons for the use of polystyrene in industry, where its use may result in a better product or in economies of operation or production. ●

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In order to avoid the mistakes into which the scientist of the 19th century fell because of his almost satanic pride, the scientific investigator of the 20th century should cultivate *humility* as his basic virtue. For, as we have seen, the whole course of development of the natural sciences and the catastrophic consequences to which this has led has prepared the scientist, unless he is completely blinded by a perverse will which makes him cry out with Lucifer, "I will not serve," to approach research with this humble attitude.

He should feel humble when he recalls how pseudoscience claimed to explain everything, whereas in reality it explained very little. He should feel even greater humility when he realizes the infiniteness of what is still unknown the more science advances. Let us recall Newton's famous comparison of his discoveries to those of a child playing by the seashore and picking up once in awhile a new seashell, while the great ocean of truth still lies undiscovered. He should have the humility of La Place who, on his deathbed, admitted how little we know and how much is still unknown. He should have the attitude of Werner von Siemens when he asserted that the more we penetrate into the forces of nature, regulated by eternal and immutable laws, the more we are moved to a humble modesty. In fine, the scientist should feel humbled when he considers the immense work of God, of which he is able to reveal only insignificant details.

José Maria Otero Navascues
Director, Optical Institute of Madrid
Through Albertus Magnus Guild.

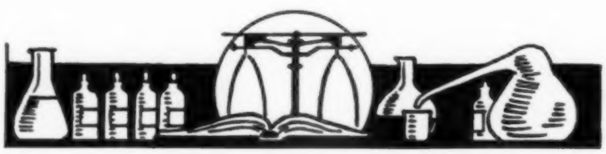
Fluorescent Lamps

(Continued from Page 15)

cause of their high efficiency, fluorescent fixtures are being used in many cases to replace obsolete incandescent globes, without the additional cost of rewiring.

The severity of many office seeing tasks, requires high levels of diffused lighting for all-day eye comfort. Besides, there is the matter of personal comfort regarding heat from light sources required to obtain these levels of illumination. Fluorescent lighting equipment, properly designed to give adequate shielding from glare, can economically provide 30 or more footcandles specified by the IES Recommended Practice for office areas.

While the foregoing examples are some of the major, more widely used applications for fluorescent lamps, they hardly constitute a complete list. Fluorescents have been used in applications ranging from refrigerated food display cases to luminous architectural elements. They will undoubtedly continue to be widely applied in the future. ●



College is the place to ask questions—and to be asked them. The Socratic dialogue is the ideal form of a college education. College is the place in which the slogans, clichés, catchwords, assumptions and dogmas on which we are brought up are examined in the light of reason. *Robert M. Hutchins*

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The increasing scientific specialization of recent years has crowded the preprofessional curriculum with so much science that there has been an increasing reaction towards the poverty of mind frequently seen in the pure science student and the medical student due to lack of general education in such fields as the humanities, literature, history, language and the fine arts. The finest of scientists would be of little value as a physician if he did not understand a bit about the world in which his patients lived and be able to appreciate fully the multitude of sociological and economic factors involved in practically all situations. Patients are human beings and if the physician of the future is to approach them and understand them as such he must have an appreciation of civilized values aside from his depth of scientific knowledge.

Edward L. Turner
American Medical Association

Harvard Summer School

2-N Weld Hall
Cambridge 38, Massachusetts

The Harvard Summer School and Graduate School of Education this year will continue their special program for secondary-school science teachers with three courses entitled, "Recent Developments in Physical Science"; "Classroom Use of Recent Developments in Physical Science"; and "Materials and Methods in the Teaching of Botany." A number of special fellowships are available for these courses, which will last from July 5 to August 17 and will each carry four units of graduate-level credit. The fellowships will cover tuition and registration fees, and some will also include allowances toward room and board or travel expenses.

In addition to these courses for secondary-school teachers, there will be a course on "Science in the Elementary School" for teachers and supervisors on the elementary level.

"Recent Developments in Physical Science" will be taught by Associate Professor T. R. P. Gibb, Jr., Director of Sponsored Research in Chemistry at Tufts College. This course will deal with the relation between recent scientific advances and the logical or historical backgrounds from which they arose, and will stress the interrelations not only between sciences, but also between contemporary developments in several fields of science and in technology. The development of nuclear power, for example will be related to basic chemical and physical discoveries, advances in metallurgy, and theories of astronomy. Other instances of such interrelations will be selected from various sciences. Recent theories concerning the structure of atoms and the application of this understanding to the development of transistors, jet engines, and plastics will be discussed. In order that the treatment of recent developments may be more than superficial, special emphasis will be placed on fundamental information and concepts. There will be lecture demonstrations, as well as frequent visits to research laboratories and industrial plants.

Supplementing this course is the one on "Classroom Use of Recent Developments in Physical Science," which will explore the ways in which recent scientific developments can be used in classroom instruction. Attention will be given to possible laboratory and project work, demonstrations, field trips, films, and available literature. Special attention will be given to the preparation of tests for science courses. This course will be taught by Associate Professor Fletcher G. Watson of the Harvard Graduate School of Education, with the assistance of Mr. Bernard Cayne.

The course for biology teachers on "Materials and Methods in the Teaching of Botany" will deal with the collection and treatment of plant material for classroom study, and to this end it will include field trips and laboratory work. It will also present a general survey of the present systems of classification, as well as a discussion of recent trends in botanical study. This course will be taught by Dr. Lawrence B. Mish of Wheaton College.

The courses can be counted for credit toward the Ed.M. or the A.M. in Teaching by those who are admitted to one of these degree programs in the Harvard Graduate School of Education.

Also of interest to teachers will be a number of other courses in the sciences including astronomy, biology, chemistry, physics, and mathematics.

Teachers interested in applying for one of the fellowships may obtain an application blank from the Harvard Summer School, 2-N Weld Hall, Cambridge 38, Massachusetts.

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The Teaching of the Natural Sciences in Relation to Religious Concepts

A Seminar Workshop for College Teachers
THE PENNSYLVANIA STATE UNIVERSITY
July 10-23, 1955

Because of the growing concern over the apathetic attitude to religion developed by students as they study science, the Danforth Foundation will sponsor for the third year a seminar workshop on "The Teaching of the Natural Sciences in Relation to Religious Concepts." The sessions will be from July 10 through 23, 1955 on the campus of The Pennsylvania State University.

College teachers of science will attack problems incident to the teaching of the natural sciences in relation to religious concepts. With a growing concern about this relationship, there has come a realization of a progressively greater need for teachers to concern themselves with religious interpretations of reality and of all human experiences. This need is present for all faiths and in all disciplines and instructional areas.

Dr. William G. Pollard, distinguished physicist and executive director of the Oak Ridge Institute for Nuclear Studies, again will be one of the Seminar leaders and lecturers. He is an experienced, successful teacher and research worker. Recently he was ordained to the Christian ministry, after several years of theological studies, carried on while directing the work of the Institute at Oak Ridge. Dr. Pollard's morning lectures and discussions will deal with "Scientific and Religious Categories of Thought" and his evening series with "The Judeo-Christian Tradition." His major themes will be the interpretation of the natural sciences and religion and their interrelations, a consideration of the nature of physical and spiritual reality, the historical development of religious concepts and insights—especially in the Judeo-Christian tradition, the application of religious principles to the analysis of our contemporary culture and modes of thought.

A lecture and discussion regarding "Educational Issues and Teaching Problems—Strategy and Tactics" will feature the second part of each morning's session. Dr. Harold K. Schilling, professor of physics and dean of the Graduate School of The Pennsylvania State

University, will deal with these matters and will consider both curricular and extra-curricular aspects of teaching. Dean Schilling, who has had many years of experience as a college teacher and administrator, has gained national recognition by his research in ultrasonics and acoustics. In his lectures Dr. Schilling will endeavor to develop a point of view on the task of the Christian teacher, identify and analyze teaching problems in the area of the relations between the natural sciences and religion, and suggest appropriate teaching techniques and materials.

The director of the seminar will be Dr. W. Conard Fernelius, professor of chemistry and head of the Department of Chemistry at The Pennsylvania State University, who has had many years of teaching and industrial experience and is a leader in chemical education.

A typical day will include two lecture-discussion periods in the morning and one in the evening. Afternoons will be devoted to study, group discussions, personal conferences with the leaders and recreation. All registrants will eat and be housed as a group. Members of the seminar will eat together at noon and in the evening. The cost of the conference, including meals and lodging, for the two weeks will be $95.00; Danforth scholarships in this amount will be available for twenty-five qualified registrants who apply before May first.

A minimum of three years of experience in teaching college courses in the natural sciences or mathematics is required for admission. It is hoped especially that younger staff members will attend in numbers since their longer period of future professional activity will be maximally rewarding from the viewpoint of the sponsors. Registrants who are eligible and meet certain requirements may earn two graduate semester hour credits.

Complete information about the program is available upon request to Dr. W. Conard Fernelius, The Pennsylvania State University, State College, Pennsylvania.

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Liberal education is education which aims at the development and perfection of a man's intellectual powers. This means that liberal education seeks to take the mind of an immature student and so sharpen and develop it that he will be able to know and to do what a man should. Every man as a man is born with innate powers. He is capable of thought, of analysis, of communication, of judgment. It is the task of liberal education to bring out these potentialities, so that man can in effect think the way a man should, act the way a man should, and in effect be a man, performing those highest functions of which he is capable.

Richard D. Weigle
President, St. John's College (Maryland)

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Richard D. Weigle
President, St. John's College (Maryland)

Examinations Committee Announces Two New Tests

A new examination, Physical Chemistry, Form L, is featured in the national college testing program of the Examinations Committee of the A.C.S. Division of Chemical Education.

Form L is a new test assembled from items submitted and criticized by about sixty collaborators. The selection of questions included is based upon pretesting under classroom conditions in over thirty institutions and an analysis of the difficulty and reliability of each question. To obtain more extensive coverage of theoretical concepts, questions dealing specifically with laboratory manipulation have been omitted.

This examination covers topics customarily treated in the year's course in physical chemistry. Section I includes gases and kinetic-molecular theory, the liquid and solid states and laws of solutions. Section II includes the laws of theromodynamics, thermochemistry, free energy, homogeneous and hetrogeneous equilibria and electrochemistry. Section III includes kinetics, atomic and molecular structure and radio activity.

Form L is a new test and norms will be established from the results of the 1955 testing program and mailed to participants.

In addition, the General Chemistry, Form K, has been reprinted. The General Chemistry Sub-committee taking advantage of this printing has gone further to clarify or improve the wording of some additional items. In a few items this may result in slightly improved student performance, which will be reflected in the new norms calculated in the summer of 1955. There should be no major problem in using the first and second printings mixed indiscriminately.

These two tests are part of the spring testing program sponsored by the Examinations Committee. In the program the following tests are featured:

General Chemistry: Form Z, Form G, Form K (new test);

Qualitative Analysis: Form Y, Form H, Qual. Supplement Form J;

Quantitative Analysis: Form Y, Form G;

Organic Chemistry: Form Y, Form H;

Biochemistry: Form X, Form Z, Form K;

Physical Chemistry: Form L.

Further information and copies of the tests may be obtained from Dr. Theo. A. Ashford, Committee Chairman, St. Louis University, St. Louis 4, Missouri. Limited copies of older examinations are available in addition to the tests featured in the testing program.

The Examinations Committee Testing Program has shown much growth in recent years. Over 48,000 students in 550 colleges and universities in the United States and several foreign countries were tested under this program last year. Many more are expected to participate this year with the publication of the new tests. ●